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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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[OFFICIAL NOTICE.]

July Meeting, Society of Gas Lighting.

OFFICE OF THE SECRETARY, June 25, 1896.

The July meeting of the Society of Gas Lighting will be held in Manhattan Beach Hotel, Manhattan Beach, Coney Island, at 3 P.M. of the 9th prox.

FRED. S. BENSON, Secretary.

[OFFICIAL NOTICE.]

Fourth Annual Meeting, Pacific Coast Gas Association.

OFFICE OF THE SECRETARY,
OAKLAND, CAL., June 10, 1896.

The fourth annual meeting of the Pacific Coast Gas Association will be held at the office of the San Francisco Gas Light Company, corner of First and Natoma streets, San Francisco, Cal., July 21st and 22d, 1896. The headquarters will be in Parlor "C," Palace Hotel. The Secretary will be in attendance at headquarters from 10 A.M., Monday, July 20th. The sessions will be convened at 10.30 A.M. and 2 P.M. The following papers will be read:

"The Economy of Coals," by Mr. John L. Howard, San Francisco, Cal.

"The Relative Position of Consolidated Gas and Electric Light Plants," by Mr. M. C. Osborn, Santa Cruz, Cal.

"Oil Tar and its Uses," by Mr. J. B. Grimwood, San Francisco, Cal.

"Telescoping a Single Lift Holder while in Use," by Mr. J. L. Fogg, San Francisco, Cal.

"Gas Stoves," by Mr. D. Decker, Fresno, Cal.

"Municipal Ownership," by Mr. John A. Britton, Oakland, Cal.

"Evolution of a Gas Meter," by Mr. Chas. H. Dickey, Baltimore, Md.

"Wrinkles," edited by Mr. T. R. Parker, Napa, Cal.

"Experiences," edited by Mr. John Clement, Red Bluff, Cal.

"Question Box."

In addition to the papers mentioned, there will be an exhibition of acetylene gas and of the Roentgen rays during the progress of the meeting.

A meeting of the Board of Directors will be held at headquarters, Monday, July 20th, at 8 P.M. The annual banquet will be held in the Palace Hotel, at 8 P.M., of Wednesday, July 22d. Thursday, July 23d, will be devoted to the social part of the meeting, which is to consist of an excursion over the electric scenic road now being built to the summit of Mount Tamalpais. The Question Box is now ready for such questions as members may choose to propound.

JOHN A. BRITTON, Secretary.

BRIEFLY TOLD.

OUR COMPLIMENTS TO ACTING-GOVERNOR WOLCOTT.—Elsewhere (p. 1045) will be found the text of the bill, which obtained the necessary legislative and executive sanction of the State of Massachusetts to give to it legal life, that incorporates the Massachusetts Pipe Line Company. While this measure is not by a very large margin fraught with the menace to the gas interests of the State that was carried by the initial bill vetoed by Acting Governor Wolcott, it nevertheless seems to us to contain enough of lurking danger, even to the point of causing us to believe that it would be better for the safety of Massachusetts gas investors in general if the bill was not enrolled on the statute books. The especially obnoxious feature, from our point of view, is contained in Section 5; but it may be that the mandate on the Board, specifying that the Board "shall grant to the Company reasonable locations," is much

weakened in point of peremptoriness by the qualifying lines of the succeeding sections. In any event, the bill which became a law is vastly fairer to the existing gas interests of the State than was the measure which the Governor's well put objections throttled. Therefore, he is well entitled to proper and positive expression of recognition of his courageous action from the gas men of the State over which he presides. This is not all, though, for which the Governor is to be complimented; and in this other respect he is likely to gain applause for his well-balanced action, not only from the Massachusetts gas men, but from the fraternity of the whole country as well. The term of Mr. Morris Schaff, of Pittsfield, as a member of the State Board of Gas and Electric Light Commissioners, would, if we mistake not, expire next month; and there were many candidates for the place, notably among whom were men who could command strong political backing. Mr. Schaff is a Democrat, and so differs in political faith from the Governor; but Mr. Schaff's course of action in connection with his duties on and of the Commission had been of so fair and straight an order that the Governor forgot politics in his remembrance of duties done and named Mr. Schaff to succeed himself. This is the sort of politics the practice of which would speedily cause us all to think there might be some good in well-carried out paternal governing.

MR. FITZGERALD SAID TWENTY, NOT THIRTY CANDLES.—In our issue for June 8th, center of second column, p. 926, in our official report of the proceedings of the second annual meeting of the Texas Gas and Electric Light Association, Mr. John H. Fitzgerald, of the Houston (Texas) Gas Light Company, is misquoted. The error, which is solely attributable to an accidental use of the figure 3, instead of the figure 2, occurred in connection with the discussion of "Question No. 2," which asked: "To what candle power can coal gas be enriched with oil without danger of smoking? To what candle power can coal gas be enriched with cannel coal without danger of smoking?" Perhaps the best way of correcting the "slip" is by giving herewith the text of Mr. Fitzgerald's letter to Mr. T. D. Miller, the Association's President, in which the former calls attention to the misquotation:

HOUSTON GAS LIGHT COMPANY,
HOUSTON, TEXAS, June 22, 1896.

MR. T. D. MILLER, President Texas Gas and Electric Light Association—*Dear Sir:* I notice, in the AMERICAN GAS LIGHT JOURNAL for June 8th, I am reported as saying: "The question of candle power is something that I will not be able to say very much about; but last August we commenced using oil gas to enrich the coal gas, and made during the winter about 30 per cent. of oil gas which carried the candle power, as near as I can tell, up to 30 candles." What I did say was: "* * * which carried the candle power, as near as I can tell, up to 20 candles." I stated the matter in that form, as I have no reliable apparatus for ascertaining the candle power, and depend entirely on a common jet photometer; but to have it go out that I made a mixed gas, of the proportions stated above, of 30 candles, would be apt to cause the fraternity to think that I am a bigger fool than I seem—however near the impossible that might appear. Yours truly, JNO. H. FITZGERALD.

Correspondence

[The JOURNAL is not responsible for the opinions expressed by correspondents.]

Mr. Jenkins Misunderstood Mr. Light.

DAYTON GAS LIGHT AND COKE COMPANY,
DAYTON, O., June 23, 1896.

To the Editor AMERICAN GAS LIGHT JOURNAL: There seems to be a misunderstanding regarding the conversation which took place last spring, between Mr. Jenkins and myself, on the subject of naphthaline and the effect of rapid reduction of temperature on gas. During our conversation I related an experience that I had just gone through, where a 20 inch inlet had been almost completely obstructed by naphthaline, and told him that I thought the cause of the formation was the rapid reduction of temperature. The figures I gave Mr. Jenkins (if I remember aright) were: Gas, at station meter, 75°; *water*, in bottom of tank, 42°; water at surface of tank, on the outside of holder, 56°; gas, at outlet, 20 feet from the holder, 52° to 56°, according to the amount being consumed. Now, in reply to Mr. Bates' question of temperature of water in tank. I think it depends on the amount of steam used during the winter months, for I know of two tanks, within 300 feet of each other, where there is a difference of from 15° to 18° in the temperature of the water—one tank having *one* steam jet in use, and the other tank three. Yours respectfully, GEORGE LIGHT.

The Measurement of Gas in Relation to Temperature.

[A paper read by MR. GEORGE LIVESEY, before the Incorporated Institution of Gas Engineers.]

The attention of gas engineers has, especially since the formation of such societies as this, been given to innumerable questions of varying degrees of importance; but, strange to say, the elementary question of the measurement of the gas made still awaits solution. The measurement of gas sold is a different matter. Only a properly constructed meter is wanted, and the thing is done. No so-called corrections for temperature are necessary or practicable. The gas as it passes through the meters on the premises of the consumers is measured at a temperature sufficiently near to that of the atmosphere to be satisfactory to both buyer and seller. The measurement of the gas as sold is the governing point. If the gas made could be measured under the same conditions, the quantity unaccounted for would be known with sufficient certainty; and one of the difficulties with which gas engineers and managers have to contend would be removed. This paper is written with the hope of inducing the Institution to deal authoritatively with the question. It would be a waste of time to give reasons why the work should be done, but the errors of the present system (or want of system) and the possible remedies may be referred to with advantage.

There have been within the last few years some extraordinary fluctuations in the quantity of unaccounted for gas. This ought not to, and unless there is an easy discoverable cause does not really, vary appreciably from year to year. The gradual but considerable increase of day pressure has, no doubt, caused a slight increase; but this will not explain a rise of 3, or 2, or even 1 per cent. in a single year. Of course, assuming that the station meter registers correctly, the cause of the fluctuations in the percentage of unaccounted for gas must be looked for elsewhere, and it probably will be found in the temperature at which the gas made is measured. This is by no means constant, neither does it bear a constant relation to the temperature of the air. If the temperature of the gas at the station meter were the same as the air, or if it were maintained at a constant but moderate figure above it, there would be no difficulty. There is, however, no approach to regularity. The relative temperatures of air and gas vary from month to month, or even to some extent from day to day, in the same works; and, so far as the experience of the South Metropolitan Company is concerned, no two works are alike.

The following table gives the relative monthly average temperatures of the gas and air taken every three hours, for the half year to December last, for each of the six stations of the Company. In every case the temperature of the gas is considerably greater than that of the air, and the difference is much greater in winter than in summer. The excess in December is in some cases as much as 20°. The make of gas in that month being about three times that of June, and seeing that the gas temperatures at no two stations are alike from month to month, it is quite clear that no average or mean temperature can be taken as a basis for correction.

Monthly Average Temperatures of the Air and Gas taken every Three Hours at the Station Meters.

	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
Air at Old Kent Road...	63°	61°	61°	47°	47'	41°	53.3°
Gas at Bankside.....	69	66	66	64	64	61	65.0
" Greenwich.....	75	72	73	63	58	55	66.0
" East Greenwich...	69	67	69	65	60	55	64.0
" Old Kent Road....	77	70	68	66	61	58	66.7
" Rotherhithe	71	72	75	60	58	52	64.7
" Vauxhall.....	73	73	74	69	66	62	69.5
Average of all stations..	72.3°	70°	70.8°	64.5°	61°	57°	66.0°

Note.—The mean temperature of the second half of the year is about 6° warmer than the first.

It may be remarked that one reason for these high temperatures is that the reduction of the sulphur compounds is thereby facilitated. This practice is comparatively recent, and to it is mainly due the difficulty about correction. When the gas was measured at a temperature near that of the air, no correction was needed.

Unless means can be found for adjusting these discrepancies, the quantity of gas unaccounted for cannot be ascertained with any approach to accuracy. The system to which the term "correcting for temperature and pressure" has been misapplied is an absurdity. Why a temperature of 60° and a pressure of 30 inches has been adopted as a standard for the measurement of gas has always been (and remains) a puzzle. As to barometric pressure, no correction is necessary, because

tl a' is the same for station and consumers' meters if on the same level; and if not, whatever variation, if any, there may be due to this cause, it is out of our power to estimate.

Pressure as known to gas makers—that is, the pressure in the gasholders and mains in excess of that of the atmosphere—must, however, affect the question of unaccounted-for gas. The pressure at the station meter varies, of course, with every lift of the gasholders—in the case of the South Metropolitan Company from about 3 inches with the top lift of the largest holders, to about 10 inches with a 5-lift holder of small diameter, when full. This, however, is reducible by balance weights. For the sake of argument, take the station meter pressure at 4 inches above that of the consumers' meters. Then taking the pressure of the atmosphere at 30 feet of water, of which 4 inches is 1 90th part (or, for convenience, say 1-100th), it follows that the gas is expanded 1 per cent.; and the quantity of unaccounted-for gas is affected to that extent, or in proportion to the actual difference of pressure at which the gas may be measured. This, however, is not a practical question; and having been mentioned, it may be dismissed.

Reverting to the question of temperature, it is necessary first to deal with the assumed standard of 60°. If this were the average temperature of these islands, one might understand why it has been adopted. But the mean temperature of London, Mr. Glaisher informs me, for the last 55 years is only 49.3°; and the farther north we go the lower it will be, in the proportion of about 1° for each degree of latitude. But supposing 60° or any other figure represented the mean annual temperature, it would still be absurd to correct to any such figure, because the quantity of gas made varies so greatly between summer and winter, or between the hottest and coldest months—July and January. The mean temperature in July, according to Table A, kindly given to me by Mr. Glaisher, is 62°, while the mean for January is 38.2° only. A correction to 60° would be about right for June to September, and altogether wrong for the remaining months. But mean temperatures are quite unsuitable, because they are means—that is, they are the result of variations above and below the average. Mr. Glaisher's second table (B) conclusively proves their unsuitability—the highest mean for July being 68.1°, and the lowest for that month 57.6°, while the corresponding figures for January are 43.9° and 31.6°. Then there are diurnal variations, which Table A shows are much greater in summer than in winter. This further increases the difficulty of making really reliable corrections for temperature—in fact, absolute accuracy is unobtainable.

TABLE A.—*Mean London Temperatures in each Month in 55 Years.*

Month.	Mean Temperature.	Mean of all Highest by Day.	Mean of all Lowest by Night.	Mean Daily Range.
January.....	38.2°	42.6°	33.2°	9.5°
February.....	39.2	45.2	34.1	11.1
March.....	41.6	49.8	35.0	14.8
April.....	47.0	57.4	39.0	18.5
May.....	52.7	64.4	43.8	20.6
June.....	59.0	71.0	49.9	21.1
July.....	62.0	73.9	53.1	20.8
August.....	61.4	72.8	53.0	19.8
September.....	57.1	67.4	49.1	18.3
October.....	49.7	57.6	43.1	14.5
November.....	43.6	49.0	37.8	11.3
December.....	39.7	44.3	34.8	9.4
Mean of year..	49.3°	58.0°	42.2°	15.8°

TABLE B.—*Highest and Lowest London Temperatures each Month in 55 Years.*

	Highest.		Lowest.	
January.....	43.9	in 1884	31.6	in 1881
February.....	45.3	in 1869	28.9	in 1895
March.....	46.2	in 1893 & 1841	35.2	in 1845
April.....	52.3	in 1865	42.9	in 1860
May.....	59.7	in 1848	48.4	in 1879
June.....	65.3	in 1846	54.8	in 1871 & 1860
July.....	68.1	in 1859	57.6	in 1860
August.....	65.8	in 1857	57.3	in 1845
September.....	63.9	in 1865	52.9	in 1877
October.....	54.9	in 1861	45.0	in 1887
November.....	48.7	in 1881	37.6	in 1871
December.....	47.6	in 1852	29.8	in 1890

In all things, however, we have to be content with something short of what we may, perhaps erroneously, consider perfection. Happily, in this case, to be approximately correct is sufficient, provided we always work on the same system, whereby fair comparisons of one year with another, or one place with another, can be made. I once, when a young man attending the late Professor Tyndall's Royal Institution lectures, in which he had been making some experiments with glass, asked him a question as to its elasticity, and remarked, "I have heard that it is the most perfectly elastic substance in nature." His reply was characteristic: "There is nothing perfect in nature." With that expression of opinion, gas makers may well be content with such accuracy in the measurement of their staple as is reasonably practicable. All they have to do is to determine how such practical accuracy can be attained. It is obviously misleading to take the registration of the station meter as the make when the temperature of the gas varies, as shown in the South Metropolitan table, from that of the air from a minimum of 5° in excess in the summer to a maximum of 21° in excess in the winter. It is equally misleading to correct to 60°; and it would also be a mistake to correct to the actual mean temperature of the year, for the reasons already given.

What, then, is to be done? The gas, as it passes through the consumers' meters, is at a temperature somewhat above that of the air. The question is, therefore, what is this excess? It is not likely that it is constant the year through, probably varying from month to month, and being greater in winter than in summer. Surely it would be possible to ascertain by experiment on a few selected and typical cases what is the monthly average excess of temperature of the gas at the consumers' meters over that of the air. To this the make, as registered by the station meter, could be corrected. Will the Institution undertake the work? An authoritative declaration on the subject would be very useful, and it is time it was made. If the meeting considers it desirable, the Council can deal with it as they think best.

Valuable information on the subject will be found in an article on "Unaccounted-for Gas,"[1] by Mr. Lewis Thompson Wright, in the *Journal of Gas Lighting* for Oct. 30, 1894, and in a paper by Mr. D. Irving, of Bristol, published in the *Journal* for June 25, 1895.

The Application of the Expansion of Fluids to Correct Measurement of Gas Passing through Meters.

[A paper read by MR. W. W. FIDDES, before the Incorporated Institution of Gas Engineers.]

The subject of this paper, as the title suggests, is the temperature aspect of the question of unaccounted-for gas. There is no intention or desire on the part of the writer to recapitulate what has been already said upon it. At no time has its importance been lost sight of, and anything that will reduce the complications involved to one of leakage only, will, it is hoped, prove of mutual benefit; for leakage, pure and simple, would then be within the limits of possible reduction.

Attempts have been made to this end by assuming that consumers' meters are measuring gas throughout the year at some normal temperature, and then correcting the volume made to that assumed temperature. What the figure for such a correction should be no one could say with certainty, as there are no possible data upon which to base the calculation; and if there were, it is highly probable that the same figure would not be suitably accommodating for use twice in succession.

Mr. Livesey, with the courage of his convictions, has given a deduction from unaccounted-for gas of 3.4 per cent. for what he considers to be applicable to the mean temperature of London—viz., 52° F. The mean temperature of the writer's neighborhood is nearer 48° F. Hence, if 3.4 per cent. be the deduction to be made from unaccounted-for gas in London to bring the statements to one of possible leakage, 4 4 per cent., on the same lines, should be the corresponding figure for Bristol.

Corrections for observed or assumed temperatures, however near the absolute truth they may be, do nothing to make up for the loss of the 3 or 4 per cent., as the case might be. This would still be going on year by year, and even if the desirability of making a correction of this kind were admitted, it would not prevent the very unpleasant reflections sometimes expressed at half-yearly meetings, etc., concerning the enormous sums of money this unaccounted-for gas annually represents. Nature, to whom this loss is attributable, has been the last to receive the blame; and if her unfailing laws have worked detrimentally in the past, it is but to look to her subservience in another direction to see a gleam of hope for the future.

The leisure of the past two years has been devoted by the writer to the subject of the influence of temperature upon the volume of gas

1. See AM. GAS LIGHT JOURNAL, Nov. 19, 1894.

that consumers' meters pass and record; and the special object of this paper is to explain how far success has attended the efforts made to secure at all times a registration of the gas delivered which shall be the standard volume at the normal temperature of 60° F.

In meters as hitherto arranged, as the gas expands or contracts in bulk, owing to changes in temperature at the place where the meters are situated, the registration of the meter has not truthfully indicated the standard volume of gas at a given temperature which has passed through it. In hot weather, for example, the volume indicated is too large, and in cold weather too small in relation to the standard volume at a given temperature. An experiment will clearly demonstrate that this is so.

In a testing room, at a normal temperature of 60° F., take two standard testing gasholders. Fill one of these with air or gas; and place the second in such a position that if (say) 10 cubic feet were transferred from one to the other, the scale upon it should record exactly 10 feet received. Take (say) a dry gas meter, and to its inlet attach one end of a long piece of lead pipe. Coil this pipe round the outside of the meter, and secure the other end to the holder filled with air. Connect the outlet of the meter to the inlet of the empty receiving gasholder. After having ascertained that all the joints are sound, and that the pointers of the holders and that of the meter are in their respective proper positions, surround the meter and the pipe coiled around it with ice or snow, and when sufficient time has elapsed to lower the temperature of the pipe and meter to that of the ice and snow, open the outlet of the first-named holder, and transfer its contents (10 feet) to the second holder. It will be found that 10 feet from the first holder will be the same volume in the second; but the meter will have registered but 9.3 feet—indicating about 7 per cent. slow in registration. In like manner, with elevation of temperature above the normal of 60° F. (within reasonable limits), the meter will record fast.

Taking the case of a dry gas meter, the volume of gas admitted to effect the pulsations of the bellows depends upon the position of the tangent pin in relation to the crankshaft. The farther the pin is moved in the slot from the crankshaft, the greater will be the extent of expansion and contraction of the bellows, which will consequently pass a greater volume of gas to effect the rotation of the crankshaft; while the nearer the pin is moved towards the shaft, the less will be the expansion and contraction of the bellows, and consequently a less volume will pass at each rotation.

The operator, in testing dry gas meters to register correctly at the normal of 60° F., places the tangent pin at a point which his experience has taught him to be near the proper place in the slot; and generally, by repeated trials—moving it either to or from the crankshaft—the true position is ultimately found, when it is permanently secured. But it is questionable whether nine-tenths of the consumers' meters or the station meters ever pass gas at the normal temperature for any length of time. Hence, when the normal temperature does not prevail, the volume passed in relation to the standard volume is incorrect.

If the tangent pin could be moved automatically nearer to or farther from the crankshaft by the influence of variations of temperature, correct registration in relation to the standard volume could be secured, for then, when the temperature was below 60°, and the gas of less than a certain density, the tangent pin would be moved nearer the shaft, and thus restrict the movement of the bellows, and a less volume of gas at each revolution would pass the meter; while if the tangent pin were moved farther from the shaft when the temperature was above 60°, and the gas correspondingly dilated, an increased volume of gas would pass for each revolution.

In order to obtain, by the influence of temperature, automatic movements of amplitude and force sufficient to move the tangent pin, numerous experiments were made with combinations of metals of varying expansibility by heat. But they were all abandoned, and it was finally decided to take advantage of the expansion and contraction of various fluids by heat and cold, in combination with various sections of tubes charged under pressure therewith. It was found, in practice, that the amplitude and also the force required could thus be obtained for any size of meter by the employment of the foregoing combinations.

The tubes employed are of oval section, solid drawn, which are afterwards bent into the circular form. They are similar to the Bourdon tube of the ordinary steam pressure gauge. These tubes are sealed at the two extremities with pieces of metal, and to one end—viz., the solidly sealed one—is attached an arm projecting to the center of the tube for fixing it to the crankshaft of the meter. This arm is also provided with a thick end-piece, into which a pin is fixed. This pin acts as a fulcrum to a lever attached to the opposite end of the tube. The end of the lever nearest the crankshaft has a T-shaped head, with a slot cut in it. Into this slot the tangent pin is inserted, and the pin can be moved to or from the crankshaft for the purpose of setting the pin in proper position for correct registration of the meter at normal temperature.

The metal piece sealing the end of the tube to which the lever is attached is provided with two holes situated transversely to each other. The hole communicating with the interior of the tube is very small. The other transverse hole is larger, and it intersects the small hole on one side, so that if a piece of wire were put through the smaller hole it would not be seen in looking through the larger one. A wire is inserted in the smaller hole, and into the larger one a filling of lead is introduced, and by pressure is compressed therein. The wire is then withdrawn, leaving a small hole through the filling communicating with the inside of the tube. Through this hole fluid is introduced into the tube by exhausting the contained air and allowing the fluid to take its place. A force pump, or the like, is attached to the small hole, and further fluid is pumped into the tube until the pressure has considerably dilated the tube, at which moment the lead filling is again compressed until the small hole through it is closed, and the lead has been forced up and down the hole. In this manner the liquid in the tube is effectually sealed under pressure.

If the amount of dilation of such a charged and sealed tube be measured at 60° F., and the tube be then cooled to 32°, the amount of contraction that it will undergo by 28° of cold will be found to be the same as the amount of its dilation by being raised from 60° to 88°, or a rise of 28° of heat. Hence, for each and every degree of rise in temperature above the normal, the tangent pin will be moved farther from the crank shaft; and in like manner with loss of temperature it will be brought correspondingly nearer the shaft. Although the operation of filling and sealing the tubes would appear somewhat complicated, it is most simple, and, in fact, occupies but a few moments.

The application of the device to a dry gas meter does not in any way interfere with its present working parts; it is simply a substitution from a rigid to a movable tangent pin, the position of which is automatically varied by the influence of temperature.

The results that will be obtained on repeating the experiment before referred to with the two gasholders, but with a meter fitted with the automatic instead of the rigid tangent, will be very different indeed. Instead of the meter recording 7 per cent. slow at 32° F., it will register exactly the same as it did when tested at 60°. In like manner, if the temperature of the meter be raised above 60°, it will register exactly the same as it did at 32° or at 60°; and it will register neither fast nor slow at any temperature to which a consumer's meter may be exposed, provided it has once been set to register correctly.

The application of the device to station meters requires that, in temperatures falling below 60°, provision should be made for raising the water-line of the meter, and, conversely, for lowering it for increase of temperature above the normal. For correcting the gas made daily, it appears that the position upon the meter where the temperature should be taken is still a debatable one. From hourly recorded observations of temperature taken upon the inlet and outlet, and also upon the water within the meter, results have been obtained which have led the writer to adopt that recorded upon the inlet only; and it appears reasonable that this should be the correct position. Inside the drum would be the right place for the thermometer; but as this is impracticable, the nearest available place to where the gas is flowing into the drum has been chosen, for the reason that any influence of heat or cold, acting upon the outside casing, is received by the outgoing gas that has already been measured, and this gas, surrounding the drum, protects it in a very great measure from external variations of temperature. In the application to station meters, for the purpose of correct registration, the temperature at the inlet has been chosen for placing the tube, which will automatically raise and lower the water line.

Referring to the temperature of consumers' meters, it is an absolute impossibility to say what average temperature throughout the year would suit the case upon which to base a calculation of correction, in order to ascertain how much was unaccounted for and how much the absolute leakage. It is in the months of November, December, January, February and March that the greatest consumption occurs. The mean temperature in this country, taken over eleven years, was 42° F.; and the bulk of the consumption is by night in these months, when the temperature is below this average. Roughly speaking, a decrease of 4° below 60° F. in consumers' meters is a loss of 1 per cent. to the gas undertaking.

Taking 52° F. as the average mean temperature for London, this would give a loss of 2 per cent.; and the value of this to the London Gas Companies alone is about £60,000 a year. With the average mean

temperature of 42° for the five winter months, the loss upon gas consumed throughout that period, generally speaking, cannot be less than 4½ per cent. But if it is taken at 3½ per cent.—practically that suggested by Mr. Livesey for the Crystal Palace District Gas Company—it would mean an annual loss to the receipts of the London Companies of no less a sum than £105,000.

Bearing in mind the enormous losses thus going on year by year, the author conceived that there ought to be a remedy; and the fruits of his labors, he feels assured, may now be reaped by gas undertakings, at the small expense of having, in the first instance, all meters of (say) 20 lights and upwards, fitted with the device he has described, which can be applied to old as well as to new meters. The larger meters particularly are those subject to the greatest vicissitudes of temperature, as they are frequently placed in exposed positions.

There is yet another out of many applications of the expansion of fluids thus attainable that will be of interest to gas engineers—viz., its use for taking temperatures in the mains, condensers, and meters upon the works. The diagram shows its application to mains thermometers. The dial may be as shown, or it may be transverse, to suit any position. In order that it may be understood, an explanation of the action of an ordinary thermometer of this description will illustrate the one for mains. For instance, take a tube from a steam pressure gauge; cut off the end where the steam acts upon the tube, and put to it a filling and sealing one. Then provide this end with a plate to secure the tube to the case of the instrument, exactly in the same place that it occupied as a steam gauge. Having filled the tube as described, it will be found that the hand rises and falls for heat and cold exactly as it did for high and low pressure steam. Nothing is left but to observe the position of the hand—say, for 40, 60, 80, and so on—and construct a scale for the degrees. The delicacy of the instrument is beyond conception.

In the writer's experiments, one such instrument had a range of three-fourths of the circumference of the dial for 10°. A main thermometer differs from this; and at first sight it might be thought that its accuracy is interfered with to some extent. But this is not so in practice, because, though the bulb in which the recording fluid is contained is away from the tube, provision is made for this in the tube itself, and also in the manner in which it is prepared for filling. The relation in bulk of the fluid in the bulb to that in the tube is so great that the temperature of the tube does not affect the index to any appreciable extent.

The breakages of the ordinary mercury thermometers are a source of constant expense, and the difficulty sometimes experienced in reading them is great; but with an instrument of the kind just described, both of these objections, it is hoped, will be met.

Mond Producer Gas Applied to the Manufacture of Steel.

[A paper read by Mr. John H. Darby before the British Iron and Steel Institute.]

In 1889 Dr. Ludwig Mond brought his process for the manufacture of producer gas with the recovery of sulphate of ammonia before the public in a presidential address to the Society of Chemical Industry. It will therefore not be necessary for me to describe the process and apparatus employed in any great detail. I will confine myself as much as possible to dealing with the improvements that have been made since that date, and with the application of the gas to the manufacture of steel.

I notice in a paper read before the West of Scotland Iron and Steel Institute in April, 1893, by Mr. George Ritchie, the following remarks in reference to the Mond producer: "The ideas embodied in this arrangement could only have come from the brain of the inventor's genius, but (as he himself remarks) the cost of the plant is considerable, and in the author's opinion we must look again for a solution of this most interesting problem." I hope to be able to show that Mr. Ritchie is mistaken, and that in its present form the Mond producer presents the most economical and efficient method of making producer gas for industrial purposes.

When fuel is gasified in the ordinary producer, the products of distillation, including tar, first leave the fuel, and the fixed carbon is ultimately converted into carbonic oxide. This raises the temperature of the contents of the producer and the resulting gas to a high degree, and is sufficient to decompose most of the ammonia originally contained in the fuel as nitrogen, as well as to effect the distillation of the volatile products. The initial heat in the resulting gas is to a great extent lost, and perhaps its only useful office is to keep the tar from depositing before the gas arrives at the point of consumption.

It is evident that at whatever temperature gas enters the regenerator, the waste gases will, when the furnace is reversed, leave that regenerator at a temperature not less than that of the ingoing gas. The sensible initial heat in the gas is therefore not utilized in the furnace, but escapes up the chimney stack without doing useful work. I should, however, remark that a small portion of the heat spoken of is commonly employed in decomposing steam in steam-jet blown producers.

The objects Dr. Mond wished to obtain in his producer plant were to utilize the heat developed by the combustion of carbon to carbonic oxide, by transferring the sensible heat in the steam and gas leaving the producer to the air and steam entering the producer. In this way he was enabled to use far more steam than is generally employed, and to work with a low temperature in the producer, preventing the decomposition of the ammonia. This enabled him to obtain the enormous yield of nearly 100 lbs. of sulphate per ton of fuel, at the same time producing a much larger volume of gas of about the same calorific value, volume for volume, compared with ordinary producer gas.

The recovery of by-products from producer gases has been the subject of much consideration, but, as far as I am aware, satisfactory results have not been obtained in using washed gases in the regenerative steel furnace. I understand that a steel furnace was erected by the Coltness Iron Company, which worked well with ordinary Scotch blast furnace gas (see analysis) before this gas was washed to recover the ammonia, etc. Subsequently apparatus was erected for the recovery of ammonia, but the steel furnace did not work satisfactorily with the washed gas, and it is at present being worked by producer gas made in the ordinary way. Cooling the blast furnace gas causes tarry vapors to be condensed, and the gas is impoverished thereby. This is possibly the reason why the furnace in question ceased to work satisfactorily with the washed gas.

Scotch Blast Furnace Gas (using Coal). (Ritchie.)

	Unwashed Average of Two Analyses by Volume per Cent.	Washed Average of Two Analyses by Volume per Cent.
Carbonic anhydride	6.80	6.30
" oxide	27.70	27.70
Methane	2.69	2.72
Hydrogen	6.81	7.55
Nitrogen	56.00	55.73
	100.00	100.00
Comparative calorific value	1,274	1,299

It is probable that the analyses of the unwashed gases do not show the value of the tarry vapors, as they would be condensed in the apparatus, and therefore not taken into account in either case.

In a furnace under my own observation, working with gas supplied from a Wilson's gas producer, the following is the difference in comparative calorific value of the gas before it entered the regenerator and after it left the regenerator.

Gas before Regenerator, probably without Tarry Vapors.

	Average of Five Analyses. Analysis by Volume per Cent.
Carbonic anhydride	7.63
" oxide	21.73
Ethylene	1.06
Methane	3.05
Hydrogen	12.60
Nitrogen	53.80
	99.87

Comparative calorific value, 1,487.

Same Gas after Heating in Regenerator, including Tarry Vapors.

	Average of Five Analyses. Analysis by Volume per Cent.
Carbonic anhydride	5.19
" oxide	24.79
Ethylene	0.41
Methane	1.33
Hydrogen	19.17
Nitrogen	48.98
	99.87

Comparative calorific value, 1,524.

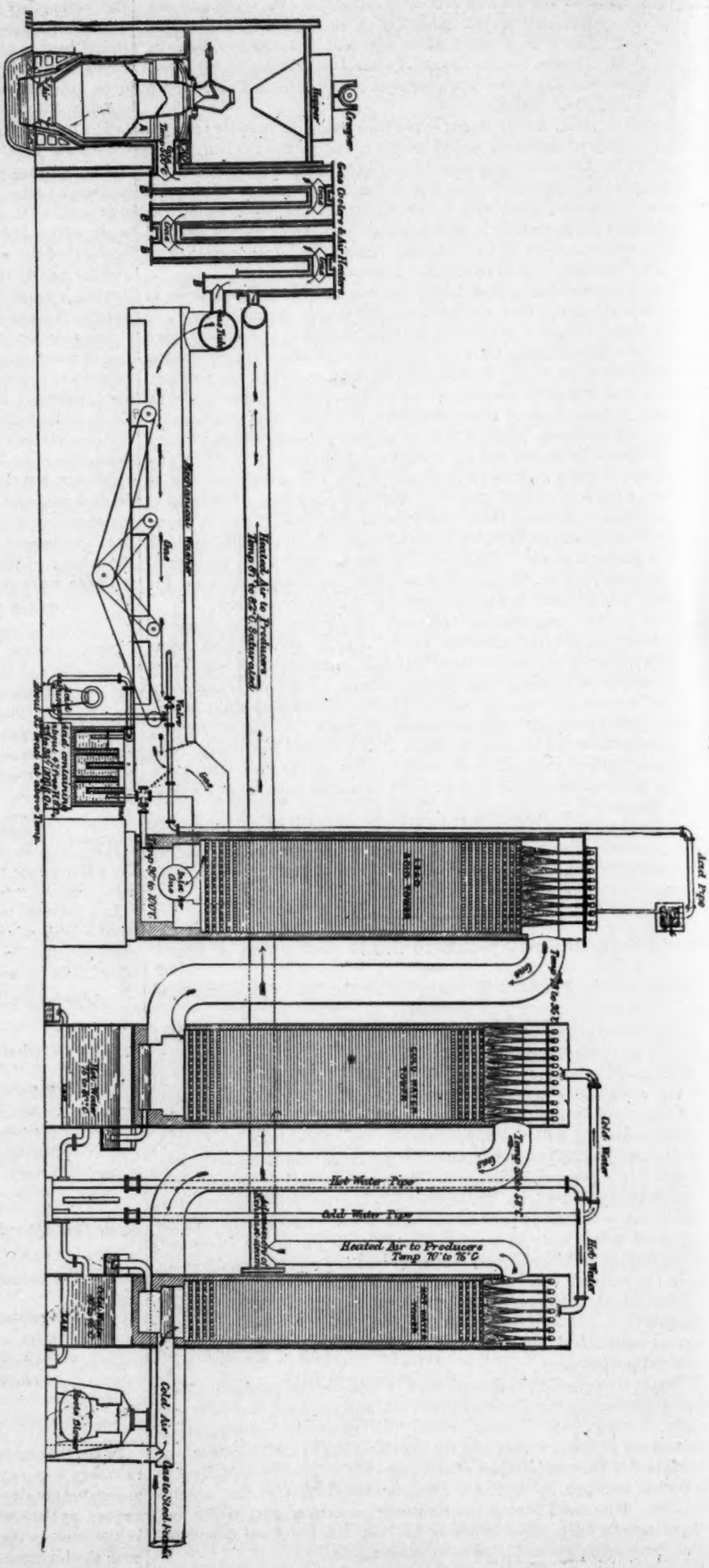
In the first instance the calorific value has been determined without the tarry vapors, which were condensed in the collecting tubes of the apparatus employed, and in the second instance it included the tarry vapors, as they were permanently fixed, and their products decomposed in the passage through the heated regenerator. This shows, together with the increase in volume, what probably is the heat value of tarry vapors in the producer gases.

Dr. Mond found that the amount of nitrogen contained in different fuels which he experimented on varied between 1.3 and 1.6 per cent. When he introduced, together with the superheated air required to burn the fuel in the producer, 2½ tons of steam for every ton of fuel consumed, he found that over 70 per cent. of the total nitrogen in the coal could be recovered, in the form of sulphate of ammonia, from the producer gases, this amounting in practice to nearly 100 lbs. of sulphate of ammonia per ton of fuel. Only about one-third of the steam introduced into the producer is decomposed in its passage through the fuel. So that two-thirds remain in the gases, leaving the producer at a temperature of 450° to 500° C. The problem was to return this steam or its equivalent to the producer, and to transfer the initial heat in the gas and steam leaving to the air and steam entering the producer for the combus tion of the fuel. The difficulties in the way of attaining this end, and at the same time recovering the small amount of ammonia in the immense volume of gas to be dealt with, are very great.

The gas leaving the producer from 1 ton of coal is about 160,000 cubic feet, equal to 4,530 cubic meters at 15° C. and atmospheric pressure. Mixed with this gas is 100,000 cubic feet, equal to 2,831 cubic meters, of steam. Under the circumstances the application of cooling arrangements, such as are used in connection with the Scotch blast furnace, is out of the question. Dr. Mond solved the problem in the following way:

The hot producer gas is passed through a series of pipes surrounded by an annular space, through which the mixture of air and steam to be introduced into the producer is led in an opposite direction, thus taking up the heat from the hot gas and becoming superheated. Thence the producer gas is led through a rectangular chamber partly filled with water, which is thrown up in a fine spray by revolving beaters so as to fill the whole area of the chamber. This water, of course, becomes hot, a certain quantity of it evaporates, and the spray produced washes all dust and soot out of the gases. From this chamber the gas, which is now cooled down to about 100° C., and is loaded with a large amount of water vapor, is passed through a leaden scrubber filled with perforated bricks, in which the ammonia contained in the gases is absorbed by dilute sulphuric acid. In this scrubber a fairly concentrated solution of sulphate of ammonia, containing 36 to 38 per cent., is used, to which a small quantity of sulphuric acid is added, so that the liquid leaving the scrubber contains only 2.5 per cent. of free acid. This liquid passes through a separator in which it is clarified. The greater portion of the clear liquid is, after the addition of a fresh quantity of acid, pumped back to the scrubber. The remaining portion of the liquid is withdrawn, and is evaporated in conical lead-lined pans furnished with lead steam coils, which are kept constantly filled by the addition of fresh liquor until the whole mass is thick. This is then run out on a strainer, and yields, after draining, a sulphate of ammonia of very fair quality, and up to the market strength of 24 per cent. of ammonia, which finds a ready sale. The mother liquor, which contains all the free acid, is pumped back to the scrubber. The gas on entering the scrubber contains only 0.13 volume per cent. of ammonia, and on leaving the scrubber it contains less than one-tenth of this quantity. Its temperature has been reduced to 80° C., and as it is not fully saturated with moisture at that temperature, no condensation of water takes place in the scrubber.

The gas next passes through a second scrubber



constructed of wrought iron and filled with perforated wood blocks. In this it meets with a current of cold water which condenses the water vapor, the water being thereby heated to about 78° C. In this scrubber the gas is cooled down to about 50° C., and passes from it to the gas main leading to the various places where it is to be consumed.

The hot water obtained in this second scrubber is pumped through a third scrubber, also of wrought iron, through which, in an opposite direction to the hot water, cold air is forced. The air is forced by means of a blower through the scrubber, and thence into the producer. The air thus gets heated to about 74° C., and becomes saturated with moisture at that temperature by its contact with the hot water, while the water leaves this third scrubber cold enough to be pumped back through the second scrubber. The same water is thus constantly used for condensing the water vapor in one scrubber and giving it up to the air in the other. In this way about one-half of the steam required for the producer is recovered and returned to the producer. The rest of the steam required is in part obtained as exhaust steam from the engines driving the blowers and pumps required for working the plant, and the remainder wherever possible from any other exhaust steam available.

The gas producers used (see illustration) are cylindrical in shape, tapering at the bottom. They are 10 feet in diameter inside the cylindrical part, and about 21 feet high. Towards the bottom of the producer casing the sides taper inward, and end in a conical grate having a round opening in the center, through which the ashes from the burnt fuel descend into the water lute, whence they are easily removed. The upper portion of the producer is provided with a cone and hopper for introducing the fuel, and underneath the cone a bell-shaped casting is placed about 7 feet long, which is kept partially filled with fuel. The casing of the producer consists of two wrought iron shells, having an annular space between them; and the air, saturated with steam, which is blown in, circulates round the producer between the two casings. In this way it is superheated and evenly distributed, and eventually finds its way through the conical grate spoken of. As the air is thus evenly distributed over the whole area where it is required, the fuel in the producer is consumed regularly, and does not therefore burn into holes.

The producer is kept filled up to the bottom of the bell-shaped casting spoken of. When fuel is introduced, it is first of all distilled, as in an ordinary gas retort, inside the bell-shaped casting. The gases given off have to force their way downwards and through the hot fuel at the point where it leaves the bell and joins the main body of the producer. The tarry vapors in their way through the hot fuel become fixed, and little or no trouble is found with the tar in subsequent operations. The gas is taken off from the producer by a pipe in the usual way, and passes up and down a series of wrought iron tubes on its way to the mechanical washer. These tubes are surrounded by annular casings, the outside of which is protected from the air by some non-conducting material. On removing the plugs at the bottom of these tubes nothing but dust issues with the gas, showing absence of tar. I am quite aware that in other producers attempts have been made to permanently gasify the tarry vapors, and in the Wilson producer an annular chamber is provided in the brickwork surrounding the freshest portions of fuel. The object desired, however, in the last producer named is not attained. It will thus be seen that the Mond gas, although washed, is not impoverished by the removal of the tarry products, but that they go forward as permanent gas. The steam-saturated air coming forward to the producer passes through the annular casings referred to, is heated in them at the expense of the initial heat in the gas itself, and in this way returns a considerable part of the heat in the gas to the producer.

The labor in connection with this producer is very low. Repairs, owing to the low temperature at which it works, are nominal. The lining in a producer which has been working for two years is now almost as good as when it was first put in. There is no clinkering, as the temperature is never sufficient to make a clinker; only rotten ash is to be found, which is almost free from carbon. There is no difficulty in stopping the plant at week ends and restarting.

The quantity of fuel gasified per producer per 24 hours is 20 to 22 tons. The details of construction of this plant will be easily understood by reference to the illustration.

The gas obtained in a dry state on an average contains:

	Per Cent. by Volume.
Carbonic anhydride	17.1
" oxide	11.0
Olefines	0.4
Methane	1.8
Hydrogen	27.2
Nitrogen	42.5
	100.0

Total combustible gas 40.4, giving about 1,350 K. C. Cals. as determined by a calorimeter, per m^3.

The calorific value of this gas, per unit of weight of fuel gasified, is higher than that of ordinary producer gas, and is equal to 80 per cent. of the calorific value of the fuel used. Producer gases do not as a rule, I am informed, carry forward more than 60 to 65 per cent. of the calorific value of the fuel.

As before stated, nearly 100 pounds of sulphate of ammonia are obtained from every ton of fuel, or 1 ton from every 23 tons of fuel.

The producer plant may be worked in two ways, either with recovery of sulphate of ammonia or without. In the latter case the plant is very much simplified, as the lead tower and sulphate plant generally are not required; on the other hand, the large revenue from the sulphate is, of course, not obtained. If the plant is worked without recovery of sulphate of ammonia, the advantages to be derived over ordinary producers are, in the first place, a greater efficiency—20 to 25 per cent. of the original fuel being saved in accomplishing the same amount of work; secondly, production of clean washed gas that will carry any distance without deposit; thirdly, a reduction of the percentage of sulphur contained in the gas; fourthly, a substantial saving of labor at the producer and low cost of repairs; and there are also many other minor advantages with this producer, which in the aggregate become an important factor.

The cost of producing sulphate of ammonia, including labor, stores, and fuel for raising the steam required for pumps, blowers, etc., but assuming that there is sufficient waste steam available to make up what is additionally wanted at the producer, and taking credit for the cost of steam used in a Wilson producer, and the saving in wages compared with same, comes to $16.64 per ton, taken from actual working. This at the present abnormally low price of sulphate leaves a substantial margin.

Mr. Charles F. Jenkin has recently pointed out, in his very interesting paper on the efficiencies of gas producers, how harmful steam is when it is carried forward in hot gas. I have shown that the steam is not by any means entirely decomposed in the producer, and if the Mond gas went forward to the steel furnace in the condition it is made, it could not, as a matter of fact, be used. I have described how Dr. Mond gets rid of the large quantity of heated steam the gas contains, and how he returns it to the producer, thus providing a continuous supply of the necessary steam. The gas is delivered for use at the ordinary temperature, saturated with vapor at that temperature For instance, at a temperature of 50° C. the gas only contains 111 grammes of water vapor per meter of dry gas, and working with gas containing this amount of moisture, there is no apparent drawback in the steel furnace. Owing to the general belief that washed gas was not satisfactory in the manufacture of steel, Dr. Mond, by my advice, determined to put down a small steel furnace to demonstrate whether his gas would work satisfactorily and give the high temperatures required quickly and efficiently. During the latter portion of 1895 a regenerative furnace was erected at the Winnington works of Messrs. Brunner, Mond & Co. It was a 3-ton furnace, and measured 12 feet between the blocks.

The best performance was a complete charge in 7 hours 35 minutes, thus working rather faster than three charges per day of 24 hours. No hitch of any kind occurred in working this furnace, nor did any trouble develop itself with the washed gas.

The steel made contained from 0.14 to 0.45 per cent. of carbon, 50 per cent. containing under 0.2 per cent. of carbon. The average complete analysis of nine casts gave the following results:

Carbon	0.240 per cent.
Silicon	0.038 "
Sulphur	0.039 "
Phosphorus	0.037 "
Manganese	0.457 "

The mechanical test of 12 samples of the steel containing from 0.16 to 0.22 per cent. of carbon gave the following results:

Cast No.		Carbon. Per Cent.	Diameter. Inches.	Breaking Strain per Sq. In. Tons.	Elongation in 8 In. Per Cent.	Percentage of Contraction of Area.	Limit of Elasticity per Sq. In. Tons.
20	1	0.17	1.14	25.6	35	50	16.4
	2	....	1.14	25.5	32	51	16.4
25	1	0.22	1.14	25.8	35	53	16.6
	2	....	1.14	27.6	32	53	17.0
30	1	0.16	1.14	25.8	36	53	16.4
	2	....	1.14	25.8	33	53	15.9
35	1	0.16	1.14	25.4	33	56	16.7
	2	....	1.14	25.2	35	56	16.1
40	1	0.18	1.14	27.3	32.5	53	17.6
	2	....	1.14	27.1	33	53	17.3
41	1	0.17	1.14	26.2	35	53	17.1
	2	....	1.14	26.3	34	51	17.4

There were no skulls in the ladle from the beginning to the end of the experiment, the metal always being hot and settling quietly in the moulds.

During the experiment 41 charges were converted into steel. Average time: Charging, 18 minutes; melting, 3 hours 9 minutes; working, 5 hours 39 minutes. Average duration of charge, 9 hours 6 minutes. Shortest time taken, including charging and repairs, 7 hours 35 minutes. Total make of steel, 99 tons 3 cwt. Yield on the metals charged, 95.33 per cent.

Description.	Weight of Materials Charged.	Used per ton of Steel.
Hematite pig iron..	79 tons. 10 cwt. 3 qrs. 0 lbs.	16.04 cwt.
Steel scrap	23 " 12 " 3 " 0 "	4.77 "
Ferro-manganese...	0 " 16 " 2 " 2 "	18.70 lbs.
Iron ore.....	16 " 10 " 0 " 0 "	3.39 cwt.

The measurements as to the quantity of gas used have been given me, but, as the furnace was drawing its supply from the works mains, it is difficult to arrive at this accurately. I would prefer to let the question of consumption rest by saying that three charges of steel were made in 24 hours, and that the amount of gas consumed by the furnace was not appreciable at the gas producer.

One of the points of difference I observed between the Mond gas in the steel furnace and ordinary producer gas was the considerable length of the flame. In a shorter furnace than the one referred to sufficient gas could not be kept on without reaching right across from port to port. With the furnace of the size given the gas seemed to thoroughly expend itself, and kept the steel at a satisfactory temperature during the whole operation with apparently a very small consumption of gas. The bath seemed to boil all over equally, and as an indication of the equal temperature in the furnace, I would mention the fact that the circulation of the slag floating on the metal, which in my experience is generally towards the incoming gas, apparently in this case ceased altogether, or, if there was any circulation, it was in the same direction as the gas in the furnace.

The experiments show conclusively that gas of the composition given is entirely satisfactory for the manufacture of the softest kinds of steel, and that it does not contaminate the metal with sulphur.

In the following table, No. 1 is the analysis of the Mond gas taken before it entered the regenerative chambers; No. 2 is the analysis of the same gas after it had passed the regenerator and been heated. The comparative calorific value is given in each case.

	Mond Gas.		Wilson Gas.	
	No. 1. Before Regenerator.	No. 2. After Regenerator.	No. 1. Before Regenerator.	No. 2. After Regenerator.
Carbonic anhydride..	17.8	10.5	7.63	5.19
" oxide	10.5	21.6	21.73	24.79
Ethylene.....	0.7	0.4	1.06	.41
Methane.....	2.6	2.0	3.05	1.33
Hydrogen.....	24.8	17.7	12.60	19.17
Nitrogen.....	43.6	47.8	53.80	48.98
	100.0	100.0	99.87	99.87
Calorific value.....	1,430	1,444	1,487	1,524

Anatyses by Volume of Various Producer Gases at 15° C.

	Mond Gas.		Brymbo.	Dowlais.	
	Own.	Brunner, Mond & Co.'s.	Average of Five Own.	By Dowlais Co.	By Bolckow, Vaughan & Co.'s.
Carbonic anhydride .	17.8	17.1	7.63	7.00	7.00
" oxide.....	10.5	11.0	21.73	22.00	31.00
Ethylene.....	0.7	0.4	1 06	..	..
Methane.....	2.6	1.8	3.05	1.00	1.50
Hydrogen.....	24.8	27.2	12.60	9.00	10.00
Nitrogen.....	43.6	42.5	53.80	61.00	60.00
	100.0	100.0	99.87	100.00	99.50
Comparative caloric value.....	1,430	1,400	1,487	1,034	1,081

Average analyses of ordinary Wilson producer gas, which is being employed continually for the manufacture of steel before entering the regenerator, and of the same gas after it has passed the regenerator and been heated, have been given before. The great difference in composition will be noted. In the Mond gas there is a great fall in the percentage of hydrogen and a rise in the carbonic oxide, while the carbonic acid has been materially reduced. In the ordinary producer gas the reverse takes place as far as the hydrogen is concerned, the carbonic oxide is increased, while the marsh gas and carbonic acid are diminished. It seems probable in the case of the ordinary producer gas that the hydrogen is partly increased at the expense of the decomposition of the marsh gas and olefines, and that the carbonic oxide is increased by the decomposition of part of the carbonic acid by liberated carbon from the decomposed hydrocarbons. The results I have placed before you are the average of those obtained by two separate chemists. Both agree within the limit of experimental error.

	Scotch Blast Furnace Gas. Sir Lowthian Bell.	Steel Co. of Scotland. By Steel Co. of Scotland.	Siemens Closed Steam Blown. By Ritchie.	Wilson Gas. By Pattison & Stead.
Carbonic anhydride ..	8.61	8.00	5.2	5.25
Carbonic oxide.....	28.06	22.00	24.4	23.66
Ethylene.....	....	....	....	....
Methane.....	4.37	4.00	2.4	3.05
Hydrogen.....	5.45	15.00	8.6	10.55
Nitrogen	53.38	51.00	59.4	57.55
	99.87	100.00	100.0	100.06
Comparative calorific value.....	1,423	1,560	1,225	1,324

The alteration in producer gases on heating is a question that requires further consideration. It would seem as though there is a tendency to form one composition at which producer gases most easily maintain themselves when highly heated, the composition of the Mond gas after heating and the Wilson gas after heating being somewhat similar.

It has been frequently stated, and I believe the late Sir William Siemens held the opinion, that non-luminous gas would not work satisfactorily in the steel furnace. Before heating, the Mond gas burns with a non-luminous flame. In the steel furnace, however, the men found no difficulty in working with the gas, and it seemed in practice when highly heated to burn with a brilliant white flame. Possibly the change in composition in the regenerators which has been spoken of may have something to do with this, as in every case examined the gas contained finely divided carbon, which was deposited on the walls of the apparatus. To show, however, that a steel furnace will work satisfactorily with what is generally known as non-luminous gas, I would instance the furnace at the Trimsaran Works in South Wales. Here the gas, I am informed, is made from anthracite coal, and is certainly before heating a non-luminous gas. I may say, in conclusion, that the comparative calorific values in this paper have all been calculated; they are in the terms of kilogramme-centigrade calories; they are, therefore, not absolute, but comparative. Great care was exercised in making the various analyses given, and they are, in almost all cases, the average of a large number made.

Coal Cutting.

In a paper on "Coal Cutting," read by Mr. Cyrus Robinson, M.E., before the combined meeting of the Western Central Mining Institute and the Ohio Institute of Mining Engineers, the author remarked that probably the greatest single economy that can be effected in and about a coal operation is in the substitution of machinery for hand labor in undercutting the coal. With the present mining rates in Pennsylvania, Ohio and West Virginia it is possible to obtain a saving of from 15 to 18 cents a ton where the breast form of machine is used. In no other branch of operating a coal mine is it possible to accomplish as much as in this one, and consequently this branch is receiving, and will continue to receive, for some time, the major portion of the attention of coal operators and mining engineers.

In considering this question it is not difficult to decide whether it will pay to install a plant or not, as there are practically no coal mines in this country where machines will not pay. In this district alone the writer's company has installed machines which, all working, have a united capacity of some 25,000 tons per day, while in the State of Ohio this is doubled. Even in the very thin veins (33 feet) of Alabama machines of their make are found to make a reduction of from 18 to 25 cents per ton, while out in Missouri and the Indian Territory, where the price of labor is much higher, the saving obtained is much greater. During the past few years we have installed numbers of machines in England, France, Austria, India and Chili. Reports from them and duplicate orders speak for the economy effected.

The advisability of introducing machines is no problem; the main, practically the only, points to be considered are: What form of machine and power are best adapted to the existing conditions at the

particular mine. Every mine presents new conditions, and the meeting of the same requires intelligent and careful consideration. I believe that the first and most important question should be: Is there any explosive gas in the mine? If there is, or even if there are only traces at intervals, I should strike out from further consideration the use of electricity for transmitting the power. It has been urged by the manufacturers of electrical machinery that a motor which does not spark at the commutator or one that does not have any commutator cannot fire gas, and consequently advise the use of electric machinery for operating the coal cutters in a gaseous mine. The danger of an explosion does not arise from sparking at the motor, for the average spark from a well-designed motor will not fire gas or dust, as it is not of long enough duration. It has been proven by experiments that to ignite fire damp it is necessary to decompose it into its component parts with evolution of hydrogen, which becomes ignited, and the heat from the flame so caused eventually raises the temperature of the fire-damp to the point of ignition. This temperature, as everyone knows, is very high, so that it is perfectly safe to state that there is no danger from the motor itself, consequently we may conclude that for their work a commutatorless motor has no advantages. The dangers arise from ruptured cables and wires, semi-short circuits caused by falls of roof, etc. Such a condition of affairs generally forms an electric arc of intense heat, and as the same is not apt to be discovered, we will say for the period of 30 seconds, sufficient time has elapsed to allow of the action described above taking place; and where gas is explosive by direct contact with a lamp, as in the case of the coal veins of the Pittsburg district lying below the bed of the rivers, it would be suicidal to install an electric plant.

If gas is present in the mine we have left for consideration only the form of machine to be used—breast machine or punching machine. If the roof and the coal are ordinarily good, it would not pay, in the writer's opinion, to consider any form of machine except the breast machine where the system of mining is room and pillar, and locomotive, long wall machine where the system followed is long walls. As this latter system is not followed in this district we will not consider it further. My reasons for making the above broad statement in favor of using the breast machines under the conditions mentioned are as follows: 1st. The coal can be undercut for about 8 cents per ton less than with any other form of machine. 2d. The coal is in better condition after it is mined. 3d. Not so much territory is required for the same output and consequent reduction of fixed charges and dead work. 4th. Ease of obtaining labor to operate such machines. 5th. The ability to cut in the fireclay next to the coal in the thin veins where it is desirous to save as much of the coal as possible. 6th. Larger yield of coal per acre and consequent increased value of the lease and property, etc.

Where the roof is very bad and it is necessary to post close to the face, the punching machine will do good work. Although I have seen numbers of mines when at first glance it would have seemed impossible to work the breast machine due to bad roof, the introduction of them has proved to be a success; the roof and conditions being very materially improved by the systematic process of machine mining, reduction of territory opened and rapidity of advancement of the face, same generally being undercut twice in 24 hours from 5 to 7 feet deep.

Where the mine is free from gas and the roof ordinarily good, it does not require a very extended investigation to prove the advantage and economy of electricity over all other systems of power transmission for your coal mine. The following table, giving the cost of wire and pipe installed, based on the present market price of material and labor, shows very conclusively the superiority and economy of the electric system of transmission as compared with the pneumatic:

Horse Power Delivered.	Distance in Feet.	System of Transmission.	Total Loss in the Line.	Cost of Line Installed.
100	5,000	Compressed air.	10 per ct.	$2,350 00
100	5,000	Electric, 250 V.	10 "	837 50
100	5,000	" 550 V.	10 "	280 00

Guided by the above figures the inclination would be to decide in favor of electric 550-volt transmission, and if the vein of coal had an average thickness of not less than 5 feet, the decision would be correct. In thinner veins, unless the distance from the power station to the point where the power is to be used exceeds 10,000 feet I would not recommend the use of a current of a higher voltage than 250; if 550 volts were used in a vein of this thickness it would be advisable to insulate the wires, and if this were done properly the cost of 5,000 feet would be about the same as 250 volts, so that nothing would be gained. Contact with a wire carrying a current of 500 volts pressure is not productive of bad results if the person's system is in normal condition; but if he has heart or nervous troubles it is apt to render him insensible and in some cases the contact would be fatal. The same proportionate conditions would obtain with a current of 250 volts, so that we may say that the only safe thing to do is to keep men with such troubles away from electric currents. In veins exceeding five feet in thickness the writer's company has installed quite a number of plants using the high voltage system; the most notable among these being: Youghiogheny River Coal Company, Scott Haven, Pa., No. 1 mine, five machines; Youghiogheny River Coal Company, Scott Haven, Pa., No. 2 mine, six machines; Knob Coal Company, Brownsville, Pa., five machines; Crozer Coal and Coke Company, Elkhorn, W. Va., five machines; Upland Coal and Coke Company, Upland, W. Va., five machines.

No trouble has been experienced in these plants from the use of their system, and it is the writer's opinion that the majority of the plants installed in the future will employ the 550-volt system.

If the first cost of the electric system is so much less, the extensions and maintenance give a still more favorable comparison; more particularly in the rooms from the cross entries to the face. When the electric system was first applied to coal cutting it was the custom to wire each room separately, running branch wires from the cross entry feeders in the same manner as the pipe branches are put in for compressed air transmission. The writer estimated that it would reduce the first cost to furnish an insulated concentric cable with each machine, having a length equal to the length of the room, and so do away with room wiring altogether. This system is now in general use and has been found very economical, not only doing away with the large investment in wire, but also with the man required to keep up the room wiring.

It is not necessary for me to enlarge upon the great advantages and economy of operation of the true and continuous rotary motion of the electric motor as compared with reciprocating engines for transforming the power on the machine, and as I have already taken up more than my share of space and time, I will close this paper and hope at some other meeting to present another one, dealing with many other branches of this very important subject.

The Text of the Bill Enacted by the State of Massachusetts which Gives Corporate Powers to the Massachusetts Pipe Line Gas Company.

Our readers will remember that the Massachusetts Legislature last May passed a bill granting extraordinary privileges to the Massachusetts Pipe Line Company. In fact, the privileges and powers granted under it were of so sweeping a nature, and so unfair to those already engaged in the gas business in the State, that Acting Governor Wolcott returned the bill to the Legislature with a statement of his reasons for disapproving it. The proprietors of the Pipe Line Company therefore prepared a new bill for the Legislature, which was eventually passed and received the sanction of the Acting Governor. The text of the substitute bill is appended:

CHAPTER 537.—*An Act to Incorporate the Massachusetts Pipe Line Gas Company. Be it enacted, etc., as follows:*

Section 1. Henry M. Whitney, Henry F. Dimock, Fred S. Pearson, James Phillips, Jr., Albert N. Parlin, George B. M. Harvey, John M. Bailey, Frank Leake, Jonas Wilder, Henry E. McCoy and John L. Wellington, their associates and successors, are hereby made a corporation, under the name of the Massachusetts Pipe Line Gas Company, for the purpose of manufacturing, buying, selling, dealing in, conveying, transporting and distributing gas for illuminating, heating, cooking, chemical, mechanical and power purposes, with all the powers and privileges and subject to all the duties, restrictions and liabilities in all general laws which now are or may hereafter be in force applicable to gas companies, except as hereinafter expressly provided.

Sec. 2. The following terms wherever used in this act shall have the application and meaning hereinafter set forth, unless some other meaning is clearly apparent from the language, context or manifest intent: The word "Company," or a pronoun in place of it, shall be taken and construed to mean the Massachusetts Pipe Line Gas Company hereby incorporated. The word "gas" shall be taken and construed as a general term for that commodity, without reference to its illuminating power. The words "illuminating gas" shall be taken and construed to mean gas of the purity and illuminating power required by general law, intended to be used for illuminating purposes by simple ignition at the burner. The words "fuel gas" shall be taken and construed to mean gas of any illuminating power, but of the purity required by general law as to illuminating gas, and in-

tended to be used for heating, cooking, chemical, mechanical and power purposes, and may be used without connection with any chimney or flue. The term "pipe line" shall be taken and construed to mean a line of mains, pipes or conduits, with the manholes and other apparatus necessary for the operation thereof, connecting a distributing system, plant for the manufacture of gas, or other pipe line, with any distributing system, plant, pipe line, town or city. The term "distributing system" shall be taken and construed to mean any system of mains, pipes or conduits, in any city or town, with the manholes and other apparatus necessary for the operation thereof, used for distributing gas from any central storage receiving point or pipe line to individual consumers or for public lights in such city or town. The word "Board" shall be taken and construed to mean the Board of Gas and Electric Light Commissioners.

Sec. 3. The capital stock of the Company shall be one million dollars, divided into ten thousand shares of the par value of one hundred dollars each. The Company may from time to time, but in compliance with the provisions and requirements of the general laws of the Commonwealth applicable to the issue of capital stock, increase its capital stock to an amount not exceeding five million dollars.

Sec. 4. The Company may, for the purposes aforesaid, and subject to the conditions hereinafter set forth, lay, construct, maintain, repair and operate its pipe lines and distributing systems in, along, through, under, across or over any public ways, water courses, railroads, railways, canals, bridges or subways; and may make such excavations and construct such works as may be necessary for the laying, construction, maintenance, repair, extension, operation and examination of such conduits, pipes, manholes and other apparatus, machinery and works. But nothing herein shall be construed as authorizing the location by said Company of any of its pipes, lines, works, conduits, manholes or machinery in, over, through, under or upon any subway, navigable water course, cemetery or public park or common or public reservation in the nature of a park, until said Company has first obtained the consent of the Board of Harbor and Land Commissioners, Park Commissioners or other authorities having control of such subways, cemeteries, navigable water courses, parks, commons or public reservations in the nature of parks. No conduit, pipe or main shall be laid longitudinally along the location of any railroad company, nor shall any manhole or other structure be erected within such location without the consent of the directors of such railroad company; but the Company may lay, construct maintain and operate its conduits, pipes or mains across or under any such location, at such times and under such reasonable regulations and restrictions as the directors of such railroad company shall prescribe.

Sec. 5. If the Company shall desire for its pipe lines the right to construct, maintain and operate the same in the streets, lanes and highways of any city or town, it shall petition the aldermen or selectmen therefor, stating the termini of such pipe line in such city or town with as much particularity and certainty as practicable, and stating the streets, highways and lanes in which the Company desires to locate such pipe line; and the aldermen or selectmen shall grant that location, or such other location in such streets, lanes and highways as they shall deem proper. In the event that said aldermen or selectmen shall for a period of thirty days refuse or neglect to grant a location, or if the Company is dissatisfied with the location granted, it may within sixty days thereafter appeal to the Board, who, after such hearing and notice as they shall deem proper, shall grant to the Company reasonable locations between said termini for such pipe line in the streets, lanes and highways of said city or town. Upon the granting of such locations by said aldermen, selectmen or Board the Company may lay, construct, maintain and operate such pipe line in the location granted. Similar rights as to additional pipe lines in the same city or town shall be obtained only by permission of the Board. The Company may, upon obtaining such locations, and subject to such regulations and restrictions in respect to the manner and time of conducting the work as said aldermen or selectmen shall prescribe, dig up and open the ground in any of the streets, lanes and highways of said city or town so far as is necessary to accomplish the object of the corporation; but such grant shall not affect the right or remedy to recover damages for an injury caused to persons or property by the doings of the Company. It shall put all such streets, lanes and highways which are opened by it in as good repair as they were when opened, and to the satisfaction of the local authorities of the city or town in which such streets, lanes or highways are located, and upon failure so to do within a reasonable time shall be deemed guilty of a nuisance. In constructing, maintaining, repairing or extending its distributing system in any city or town the Company shall be subject to all the restrictions, regulations and liabilities set forth in section 75 of chapter 106 of the Public Statutes, except as in this act provided; and in the construction, maintaining, repairing and extending of its pipe lines and distributing systems it shall in all cases be subject to the restrictions, regulations and liabilities set forth in sections 76 and 77 of said chapter 106. If in making such excavations any water or gas pipes, sewers, drains conduits or other subterranean works are disturbed or interfered with, the same shall, at the expense of the Company, be restored to as good condition as they were in before such excavation. All locations granted under this section shall be subject to revocation by said aldermen or selectmen respectively, subject to the approval of said Board.

Sec. 6. The Company may, subject to the approval of the Board, and upon such terms and conditions as may be mutually agreed upon, and as may be approved by the Board, purchase, lease or operate the works, distributing system and other property of any person, firm, corporation, town or city engaged in the business of selling or distributing gas, or any portion of such works, distributing system or other property in any city or town in which the Company has laid a pipe line: *Provided, however*, that nothing in this act shall authorize the Company to issue new capital stock or bonds for the purpose of such purchase in excess of the amount issued by the corporation whose works are purchased; and such person, firm, corporation, town or city may sell or lease any of its works, distributing system or other property to the Company as aforesaid. The Company may thereupon use the said works, distributing system or other property for the purpose of selling gas to the inhabitants of the town or city within which the same are situated; *provided, however*, that in case of any such purchase, lease or operating contract the prices charged by the Company to individual consumers or for public lights shall thereafter be suject to the jurisdiction of the Board, as provided by section 9 of chapter 314 of the acts of 1885, and shall not in any case exceed the prices ruling at the time of such purchase, lease or operating contract; nor shall the Company discontinue any portion of the distributing system it may acquire by any such purchase, lease or operating contract, but shall be subject to the provisions of section 5 of chapter 346 of the acts of the year 1886.

Sec. 7. The Company may sell or deliver fuel or illuminating gas to any gas company or to any town or city authorized by law to distribute gas; and any gas company and any such town or city may contract for the purchase of gas of the Company for such term of years, and on such conditions as may be mutually agreed upon; but the prices charged by the Company for such fuel shall not exceed the following amounts per 1,000 cubic feet for fuel gas of a heat value not less, on the average, than 580 British thermal heat units, delivered at the holder or mains of any such gas company, town or city, at the following distances from the State house: 20 cents within five miles, 25 cents between five and fifteen miles, and 30 cents beyond 15 miles, and not exceeding 5 cents additional in each case for illuminating gas of the candle power required by law. In any city or town having the right to manufacture or distribute gas the Company shall supply such city or town with gas for distribution upon the same terms as it shall supply it to any gas company distributing gas in such city or town. The price charged by the Company for fuel or illuminating gas to individual consumers shall not exceed the following amounts per thousand cubic feet, as herein provided: Within eight miles of the State House, 60 cents; to the inhabitants of any city outside of the above limit, having a population of more than 75,000, 75 cents; to any other city outside of said limit, 90 cents; to the inhabitants of any town, $1.25. The Company shall not sell gas to individual consumers except as provided in section 6 of this act.

Sec. 8. The Supreme Judicial Court and any justice thereof, and the Superior Court and any justice thereof, shall have jurisdiction in equity, on petition of any party interested, to compel compliance with the provisions of this act and to prevent any violations of the provisions thereof.

Sec. 2. This act shall take effect upon its passage. [*Approved June* 9, 1896.]

Comment on the Pipe Line Bill.

A correspondent forwards the following comment on the Pipe Line Bill, as per the preceding text:

To the Editor AMERICAN GAS LIGHT JOURNAL: The bill to incorporate the Massachusetts Pipe Line Gas Company, which has passed the Massachusetts Legislature of 1896, and become a law, under the present provisions does not apparently go into direct competition with any ex-

isting corporations, since it is limited, in its own words, by the clause that "the Company shall not sell gas to individual consumers except by the purchase or lease of the works, distributing system and other property of any person, firm or corporation, town or city."

It is essentially a bill granting permission for the laying of a pipe line, subject to the approval of the Board, and subject to revocation, and still further restricted by prices which limit the sale of fuel gas 20 cents within 5 miles of the State House; 25 cents to a distance not exceeding 15 miles; and 30 cents beyond; and not exceeding 5 cents additional in each case for illuminating gas of the candle power required by law, with the maximum prices: Within 8 miles from the State House, 60 cents; in cities more than that distance, having population over 75,000, 75 cents.; and any other city, 90 cents; and to customers in any town, $1.25.

Thus, the practical working of the bill will be quite difficult without further legislation, as seen from an engineer's point of view.

The effect upon the market has been to bear stocks in which the incorporators were most interested, for while the new law fixed the capital at $1,000,000, with the right to increase to $5,000,000; bonds to an amount equal to its outstanding capital can be further issued. A clause in the bill prevents the issue of more stock or bonds for the purchase of any works than the amount already issued by the purchased corporation, which practically forbids the purchase and incorporation into pipe line companies of the companies who have been successful enough to have their stock quoted at 150 to 200, as is the case of many of those around Boston.

Another striking feature of the bill is that while, as originally planned, the existing laws of the State, the supervision by the Gas Commission and the municipal ownership law, were to be overrun and made void, in the bill as now presented (and which, by the way, is the Bailey bill so called, and not the Whitney bill), the utter disregard of existing rights has been overruled, and the Legislature have passed the new Company under the provisions of the Gas Commission and of the common law.

It is a matter of congratulation that the implied contract between the gas companies and the State, which the formation of a Gas Commission implied, should have borne so crucial a test, and that the publication of the status of the gas and electric companies has proved that the companies are under the supervision of the Gas Commission, can be trusted to turn out their product as cheaply, and, on the whole, as intelligently as could be expected.

Some criticisms which were made in the opening arguments by the petitioners, the constant feeling that all had not been quite honorable in the matter of the manufacture and sale of gas and electricity, and the cry for gas at 35 cents per 1,000, which the promoters of the Whitney bill made, have developed their full value in the course of the hearing.

No one disputed the claim that cheap fuel gas was desirable, or that a cheap illuminating gas could be sold in large quantities, but the courage of the Governor in vetoing what had all suspicion of being an experiment has met the approval of the Legislature and the sober second thought of the community.

Fighting the Frost.

[Communicated by Mr. Norton H. Humphrys, Assoc. M. Inst. C.E., F.C.S., to the *Journal of Gas Lighting*.]

For the same reason that Christmas stories, depicting scenes of frost, snow and winter cold, are written during the sweltering days of July and August, the prudent gas manager finds it advisable, in the slack summer season, to make a quiet forecast of his probable position in December and January next ensuing. A few words on the subject above named will, therefore, not be out of place at this period of the year. During the exceptionally severe weather that prevailed in the early part of 1895, I heard so much about portable boilers, hot water circulating devices, and other efficient but also cumbrous appliances for preventing the freezing of gasholder and purifier lutes, or for thawing those already frozen, that I am led to think that two important points are not so well known or appreciated as they deserve to be. The first is that, with a reasonable boiler capacity, there is already a sufficient power on the works for efficiently dealing with the troubles due to frost; and the second, that a line of steam pipe laid on to the gasholder and purifier yards, with connections at suitable intervals, to which a 20 feet length of flexible metallic tubing can be coupled up at a few minutes' notice when required, is a valuable acquisition at times whon the mercury falls below freezing point.

It is a matter for surprise, in these days when inaugural addresses and papers fall thick and fast, that someone has not ere now directed attention to the utility of flexible metallic tubing for many purposes in gas works. It is applicable for either steam, water or gas, and is especially valuable as a substitute for india-rubber tubing in the retort house. It is made either in galvanized steel or copper bronze; and it is sufficiently strong to be perfectly tight, not only with gas or water, but also with steam up to any reasonable limit. For any work in holes and corners—such as retort setting or boiler scraping—the advantages of a flexible tube that will bear any reasonable amount of heat, and stand being trodden upon without injury, are obvious. For stove or meter testing, or for the laboratory, flexible metallic tubing is free from the well known objections to rubber tubing, and is very serviceable in connection with a portable photometer.

Towards the close of the summer of 1894, the writer had completed a new gasholder with cast iron tank. The latter is 105 feet in diameter and 25 feet deep, of which nearly 20 feet is above ground level, and the site is very exposed—being without any shelter whatever on the north and east sides. Having decided that ice must be practically prevented from forming in this tank, the next question was how it was to be stopped. Mentioning the matter to various friends as opportunity arose, a suggestion was made to "Go and see Lloyd at Guildford," which was eventually acted upon. I found Mr. Lloyd brimful of good nature and willingness to give the fullest possible information on steam thawing or any other of the numerous little conveniences which he has arranged on his works. The suggestion proved to have been well founded, and I obtained full particulars respecting the special matter I had on hand, with several other things thrown in, and am entirely indebted to Mr. Lloyd for the means of successfully encountering the frosts of 1895. He showed me some aspirators or injectors, made up of wrought iron pipe and fittings, in which a jet of steam drew in a current of water and ejected the same from the nozzle, after the fashion of a jet exhauster; and he pointed out that it was not only the heat derived from the condensation, but also the maintenance of a gentle current round and round the cup or tank, that served to prevent the formation of ice. The injector was placed just below the water surface, parallel with the tank and holder side at that point; and a cork thrown into the current issuing from the nozzle of the injector floated right round the circumference of the holder in a few minutes. This system also has the advantage of completely condensing the steam, utilizing the whole of the heat, and preventing the escape of any visible vapors.

On returning home, some experiments with steam raisers, home made injectors, etc., were at once put in hand, and these incidentally had an unexpected but very useful effect. At the time when the long frost commenced, nearly the whole of the tanks and lutes on the works had been warmed up to about 60°, and thus had a very good start. The water in a below-ground tank was found to lose temperature very slowly, and would have stood several days of severe frost before ice was formed. The same effect was observed in a less degree in the cups and purifier lutes; and this suggested the advisability of a good warm up all round on the approach of frosty weather. The experiments were directed towards finding the best form of aspirator for inducing a steady current with a ripple on the surface of the water; and the best results in this respect were obtained with an apparatus constructed very much on the principle of a Bunsen burner, having a conical nozzle, an enlargement corresponding to the air-chamber, and a jet for the steam, in the same position as the gas nipple. This article is supplied by engineering firms under the title of a steam tank water heater, and is used for warming large volumes of water in breweries and other places by means of wet steam. One such aspirator is sufficient for the new tank especially referred to, and a similar one is fixed to the cup and supplied with steam by a length of flexible metallic tubing. This arrangement is taken away in the spring, and refixed as soon as the cold weather begins. The largest aspirator we have in use has a steam jet ⅜-inch diameter at the nozzle, and is connected to an ordinary 1-inch steam pipe.

There are several reasons why it is better to prevent the formation of ice in gasholder tanks—and especially in cups and purifier lutes—if it can be done by convenient and simple means, in addition to the saving of labor in breaking ice. More than once the writer has had to re-sheet the cup of a gasholder; and the old sheets have shown unmistakable signs of injury from attempts to break ice, in the form of deep scratches, bruises and dents, notwithstanding the strict rule that wooden rammers only should be used. The act of freezing must necessarily set up strains similar to those which are manifested by the bursting of water pipes; and just at the time when the frost comes the holders are sure to be in active operation—causing risk of trouble on

account of the binding of ice, or the hanging up of partly ice-bound cups. The date when a gasholder gets out of truth could probably be traced to a severe frost; and besides the question must be considered of maintaining a proper supply pressure. All this can be avoided by the simple and inexpensive means above indicated.

For those who are already in a tight place as regards boiler capacity there is an easy way out of the difficulty—namely, to put down a feed water heater, by means of which the temperature of the feed-water is raised to 160° or more before entering the boiler, and at the same time a supply of warm condensed water is obtained. This not only means a saving of fuel—itself not an important matter, as the gas works boiler is (or ought to be) heated by means of screenings from the breeze and coke heaps—but also a corresponding reduction in labor. If hard water is used a large proportion of the scale is deposited in the heater and prevented from entering the boiler. There is no risk of reducing the steam pressure a few pounds, which sometimes occurs when cold water is supplied in larger quantity than usual, and is responsible for the curious lines that one would rather not see on the exhauster register and station meter tell-tale. The waste steam superheater is not so generally used in gas works as it should be; and the economy secured by its introduction will more than compensate, under ordinary working, for the additional demands due to putting on the steam non-freezing apparatus.

SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, ENGLAND, June 10th, 1896.

A New Naphthaline Prevention Process.—The Incandescent Gas Light Company.—Glover's Padlock for Automatic Meters.

A novel process for the prevention of naphthaline deposits in gas mains and service pipes has been patented by Mr. C. E. Botley, the engineer and manager of the Hastings Gas Company, in conjunction with his son, and has been in operation for some time in that beautiful seaside resort. It possesses the advantages of simplicity and cheapness, and though one result of its use is a small deposition of fluid, which drains into the street drip boxes, the gas is not impoverished in illuminating power. The fluid is said to contain not more than 6 per cent. of naphthaline, so this process is evidently intended to retain the troublesome hydrocarbon and carry it comfortably along to the burner, and not to get rid of the difficulty by the brutal operation of absorbing a valuable illuminant out of the gas. Its action is that of a soothing dose of physic rather than the surgeon's lancet. It is applied at the outlet of the gasholder, where a small portion of gas is abstracted, compressed to a high degree, passed through an apparatus containing petroleum and returned to the bulk, carrying with it a sort of cloud of very finely atomized petroleum. The main is thus filled with a visible whitish mist of oil in a vesicular condition, which is said to be sufficiently permanent to follow the gas to the extremities of the district, and to effectually interfere with the crystallization and consequent deposition of naphthaline. Its action must not be confounded with that of ordinary carbureters, as the proportion of fluid used is too small to affect the illuminating value, being only about one gallon per 50,000 cubic feet of gas. Ordinary commercial petroleum, having a specific gravity of 0.820 to 0.840, is the fluid used. It is to be hoped that the results of extended trials will prove that this apparatus is efficient under all the varying conditions which appear, according to the experiences in different districts, to be concerned with and to favor the deposition of naphthaline. The production of a visible cloud or fog leads one to speculate as to the practical advantages that would follow if a visible tinge or color could be bestowed upon gas sufficiently pronounced to render escapes visible to the eye, as is the case with steam pipes. The fact that Mr. Botley converts liquids into a finely divided vesicular or cloud-like condition, possessed of a certain degree of permanence, is very interesting from a general point of view, and may prove applicable to other purposes.

The annual meeting of the shareholders of the Incandescent Gas Light Company has just been held, and the statements respecting the business done during the year ended March 31 last, as disclosed in the reports submitted on that occasion, furnish some interesting information as to the progress made in the practical application of that special form of gas lighting. Notwithstanding the reductions in the price of the appliances the company continues to make enormous profits, that for the past year amounting to over 60 per cent. on the capital invested—that is to say, on the face value of the shares, which probably is rather a different thing. So it is no wonder that other firms exhibit a desire to get into the incandescent line of trade. The way in which this appliance has been financed from the first is an interesting study for all concerned in the development of joint stock enterprise and the doings of companies generally. The records of the last four years show a sale of 20,000 burners in 1892, 105,000 in 1893, 300,000 in 1894 and 600,000 in 1895, from which it would appear that through the operations of this undertaking alone there are now over one million incandescent gas lights in use. It would be interesting if some information were forthcoming as to the forms of lighting that have been thus displayed. The honors in this respect are divided between other forms of gas burners, incandescent electric lamps, oil and candles, which have all at one time and another been compelled to give place to the new comer. Assuming each burner to require four mantles per annum, it would appear that the established trade in mantles alone means a turn over of £200,000 per annum, to which must be added nearly an equal amount for chimneys and shades. Remembering the results of recent legislation, in addition, it must be conceded that the concern is in a very satisfactory position.

There is an antidote, it is said, for every poison. One objection experienced in the use of automatic prepayment meters is the temptation thus offered to persons of a crafty and thievish turn of mind. The party who violently wrenches open the cash box and appropriates its contents is bad enough. When one finds the cash box fastening taken off and the till empty the presumption is pretty clear as to where the money is gone. But a customer who is wily enough to obtain a key or other instrument that will enable him to open the padlock without injury is much more difficult to deal with, especially if he is knowing enough to limit his peculations to a small proportion of the contents. It is difficult to ascertain if the correct amount has ever been inserted, and whether the shortage is really the result of dishonest practices or due to the meter not cutting off properly when each pennyworth has run out. And if on removal and examination the device is found to be in efficient order there is nothing to prove that it has not hitched when in practical operation. Disputes have already arisen as to the amount in the till, the consumers claiming to have put in a sufficient sum to correspond with the meter indications, while the collector makes it something short. Messrs. Thos. Glover & Co., the well-known meter makers of London, have just introduced a neat and simple little device that aims at avoiding difficulties of this sort by putting a seal on the padlock, thus rendering it impossible to open or tamper with it without at the same time leaving unmistakable evidence of the attempt. The place which forms the front of the padlock has a tongue or extension at the bottom, and the protecting cover that is usually placed over the keyhole is made long enough to register with this extension when the keyhole is covered. A hole is then drilled through the two plates. The gas company's collector carries with him a box of leaden rivets or eyelets fitted to and suitable for closing up these two holes, also a pair of pincers with the crest of the company or any suitable device cut on the faces. Having locked the padlock, he puts the cover in position, passes a rivet through the two holes, clinches it with the pincers, which at the same time leaves the device impressed on each side, and so leaves the keyhole covered and not getatable without breaking the seal. On the occasion of his next visit he simply cuts off the back of the rivet with a knive, and after making the examination locks and seals it as before. Glover's patent padlock can be attached to any make of meter, and is certain to be largely adopted by gas companies.

Yesterday the 33d annual meeting of the Gas Institute was opened in London by the President, Mr. W. R. Chester, the Engineer and Manager of the Nottingham Corporation Gas Works. The spacious hall belonging to the Society of Arts was completely filled with a good, representative gathering, and it soon became evident that the President's well-known active and methodical habits had permeated the meeting, and that business was the order of the day. I never attended a meeting where business went more steadily and smoothly, with no undue hurry or fluster, and no loss of time. On the table to right of the President stood a massive silver center piece which bore silent but none the less eloquent testimony as to what the members of the Institute think of Mr. Jos. Hepworth, the late Honorary Secretary, who had held that responsible office for five years with credit to himself and to the satisfaction of all concerned. The presentation of the testimonial will take place in the course of the proceedings, and will not form the least interesting feature. The report of the Council told of a goodly increase of members, and of an excellent financial position, and was received with that absence of criticism that is perhaps the highest possible compliment. The presidential address was listened to

with great attention, and it very soon became evident that the high expectations which had been formed respecting this part of the programme would be fully realized. It dealt largely with public statistics and known facts rather than with the personal experiences and opinions of the author, and all agreed with the mover of the subsequent vote of thanks, to the effect that the address in question would form a valuable contribution to the proceedings, and fully maintain the old traditions of the Institute. One interesting feature that will carry comfort to the hearts of timid shareholders was the comparison between the annual sales of electricity and gas as shown by the Government returns, which go to prove that the total sale of electricity throughout the United Kingdom is little more than half the *annual increase* in the sale of gas. These are words for the times, when so much is said about the progress of electricity, and many are led to the not unnatural conclusion that the sales of gas must suffer in consequence. The reading of the communications and papers was well started by Mr. E. Lloyd Pease, the inventor of a system of guiding gasholders by means of steel ropes in place of the ordinary framing, who described several structures on this principle that are actually completed and in operation. Mr. Pease finds from actual experiment that the wind strains on a gasholder are so small that they may be neglected in practice, as the pressures registered during stormy weather do not exceed 3 pounds per square inch. Mr. Webber went further than this in the discussion, and contended that any holder strong enough to keep its shape when inflated could be relied upon to resist any reasonable wind pressure. But against this it was remarked that wind pressure cannot be limited. It was possible that the holder might be called upon to encounter for a few minutes a degree of pressure that had never come upon it before, and would never come again. Another gentleman thought that on a stormy night he should retire to rest in a happier frame of mind if he knew that his holders were inclosed in a good, strong framing than would be the case if they were guided by ropes. Mr. Pease founded his conclusions, however, not on mathematical formulæ or abstract propositions but on actual tests taken on gasholders in ordinary working, and therefore whatever one or another might think, there was no denying his figures.

To-day the principal feature of the proceedings was a lecture by Prof. Clowes, of University College, Nottingham, on methods of detecting and measuring dangerous or explosive proportions of combustible gases in air. This is a matter that has lately acquired great practical importance. There is the question of the air of coal lighters, or of petroleum tank steamers; of alleged leakage of coal gas into electric culverts or drains; of the atmosphere in coal mines, and others that might be mentioned, wherein the presence or otherwise of an explosive or poisonous proportion of gas becomes really a matter of life or death. Prof. Clowes has been giving attention to this matter for some time past, and the result of his investigations is the invention of a very neat and simple little apparatus which can be carried in one hand, set up anywhere on an ordinary tripod such as is used for photographic cameras, and a sample of air can be tested in a few minutes by ordinary inspection, similar to the process of taking a reading on the photometer, as the height of a flame is observed and indicated on a scale by a pointer. The demonstrations accompanying the lecture were excellently carried through, and they included the explosion of different mixtures of gas and air, an example of the blood, or as it is more scientifically and euphoniously termed, the hemoglobin test of carbonic oxide, the fact that a pure hydrogen flame will burn in an atmosphere that is foul enough to smother the flame of an oil lamp or candle, and several diagrams and illustrations of apparatus projected on a screen by the medium of an oxy-hydrogen lantern. One important fact that gas men will fully appreciate was that an explosive mixture in which the proportion of gas was so small that it would not ignite when a flame was applied from below, as when a glass cylinder charged with the mixture was held above a Bunsen burner, fired immediately when the jar was placed down on the table and the light applied from above. This goes to explain why so many explosions of gas have resulted from carrying a light to the upper part of a room. It is not necessary to go into the details of Prof. Clowes' apparatus and process as it has already gone the round of the scientific press.

SUPERINTENDENT SCOTT, of the Lewiston (Me.) Gas Light Company, is getting along nicely with the important scheme of pipe extensions arranged this spring. The plan provides for about four miles of mains in districts hitherto not supplied with gas. It is also proposed to put a main across or along the Dennison street bridge for the supply of the adjacent hamlet of Perryville.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

AMONGST the amendments to the local tax ordinances of Atlanta, Ga., is one which declares that "Gas works or Companies, whether doing business jointly or otherwise," shall each pay a license fee of $200. Under the old ordinance the fee was $50.

THE Board of Directors of the Paterson (N. J.) Gas Light Company have perfected the following organization: President and Treasurer, John Reynolds; Vice-President, William L. Williams; Secretary, Robt. Schoonmaker.

THE following is the text of the information furnished by the proprietors of the Brooklyn Union Gas Company to the authorities of the New York Stock Exchange, when the former made application to have their securities listed on the Exchange:

"The Brooklyn Union Gas Company respectfully applies to have the following described bonds and stocks issued by it placed on the regular list of the New York Stock Exchange, viz.: $12,336,000 consolidated mortgage 5 per cent. 50-year gold bonds, New York Guaranty and Indemnity Company, Trustee, dated September 16, 1895, and due May 1, 1945, with interest at the rate of 5 per cent., payable May 1 and November 1, of each year, at the office of the Company in Brooklyn, or its financial agency in New York, each bond of the denomination of $1,000, and numbered from 1 to 10,600 inclusive, and 11,101 to 12,836 inclusive; $15,000,000 of capital stock of the Company, being 150,000 shares of $100 each.

"This Company was organized on September 9, 1895, under the general laws of the State of New York, and on November 4, 1895, acquired by purchase, subject only to existing mortgages thereon, all the property, rights and franchises of the following Companies theretofore engaged in the business of selling gas in the city of Brooklyn, N. Y., namely: The Brooklyn Gas Light Company, the Fulton-Municipal Gas Company, the Metropolitan Gas Light Company, the Citizens Gas Company, the Williamsburgh Gas Light Company, the Peoples Gas Light Company and the Nassau Gas Light Company.

"The Company paid, in consideration for the property, rights and franchises of said Companies, $15,000,000 par value of its capital stock, being the whole thereof, and $15,000,000 par value in its consolidated mortgage 5 per cent. bonds; but $3,900,000 par value of said bonds were appropriated and reserved with the Trustee under the mortgage securing the same, to be exchanged for or used to retire or pay the underlying bonds of the several vendor Companies, and $500,000 par value of said consolidated mortgage 5 per cent. bonds were appropriated and are held by the Trustee to be used only for the purchase or acquisition of additional property or for improvements.

"Since that date $2,164,000 of the bonds reserved have been issued in exchange for or to take up an equal amount of said underlying bonds so that the amount of said consolidated mortgage 5 per cent. bonds of the Brooklyn Union Gas Company now outstanding is, as above stated, $12,336,000, none of the bonds reserved to acquire additional property or for improvements having been issued.

"The property of the Company consists of seven different gas works, with all the necessary appliances for manufacturing and storing gas, and seven separate and distinct systems of mains, connections, services and meters for the distribution of gas throughout the entire city of Brooklyn, except in towns recently annexed to said city, and the estimated value of said properties is over $30,000,000.

"The property, rights and franchises of the vendor Companies were duly transferred to this Company by proper deeds and other instruments of conveyance, under the authority conferred at meetings of stockholders of such Companies, at which the propositions made by this Company were accepted by a unanimous vote, except in the case of two Companies where the votes were practically unanimous.

"Under the terms of the contracts stockholders who deposited their stock with the New York Guaranty and Indemnity Company received in exchange therefor prescribed amounts of bonds and stock of this Company, and those declining to deposit their stock were entitled, under the laws of the State of New York, to apply to the proper court for the appointment of appraisers and to be paid in cash the appraised value of their stock. Nearly all the stock of all the Companies has been deposited and no stockholder has asked for an appraisement.

"Under the laws of the State of New York authorizing this amalgamation the vendor Companies have now no corporate existence.

"This Company took over these properties November 4, 1895, since which time the monthly earnings and expenses, to April 30, 1896, were approximately as follows:

Date.	Gross Earnings.	Expense.	Net Earnings.
November, 1895	$390,200.64	$190,215.58	$199,985.06
December, 1896	423,218.68	217,114.49	206,104.19
January, 1896	433,341.84	216,630.79	216,710.85
February, 1896	374,825.67	196,206.03	178,619.64
March, 1896	335,274.86	187,894.44	147,380.42
April, 1896	298,084.84	180,180.42	117,904.42
Total	$2,254,946.33	$1,188,241.75	$1,066,704.58

"The fixed charges of the Company will be approximately $750,000 per annum. First balance sheet of the Company is in course of preparation, and will be forwarded to you as soon as completed. The Guaranty Trust Company is the Transfer Agent and the United States Mortgage and Trust Company is the Registrar of the stock of the Company.

"The Directors of the Company are: George W. Young, George R. Turnbull, Jno. T. Mills, Jr., Grant B. Schley, W. B. Dickerman, H. H. Durand and C. E. Bell. The officers of the Company are: President, Geo. W. Young; Vice President, John T. Mills, Jr.; Treasurer, E. R. Chapman; Secretary, F. W. Wilcox."

THE Board of Gas and Electric Light Commissioners of Massachusetts have handed down their determination in the matter of the application of the Athol (Mass.) Gas and Electric Light Company for the right to increase its capital. The petitioners asked the Board to sanction an issue of $25,000 additional stock, and $50,000 of bonds, the proceeds to be devoted to paying off the existing indebtedness, for enlarging the plant, etc. Having heard the argument on the application, the Board took the matter under advisement and eventually decreed that the Company might issue $15,000 of stock and $40,000 of bonds; and an order in consonance with that finding was issued.

THE contract for the new station meter house building of the New Haven Gas Company has been awarded to Mr. George M. Grant.

PRESS despatches of last week are to the effect that a jury, in Judge Dunne's Court, Chicago, returned a verdict in favor of Donahue & Henneberry, to whom was awarded the sum of $65,636.31 for damages done on buildings, Nos. 407 and 409 Dearborn street, Chicago, owned by plaintiffs, through an explosion of gas. The defendant was the Chicago Economic Fuel Gas Company.

ELSEWHERE we note that the City Council, of Atlanta, Ga., had determined to raise the license fee for gas companies operating in that city from $50 to $200 per annum. Judge Howard Van Epps subsequently appeared before the Council to remonstrate against the proposition, and his argument was forceful enough to cause the Council to order a restoration of the license fee to the old figure.

IT looks that the Macon (Ga.) Gas Light and Water Company, which has been for some time in the hands of a receiver, will speedily be reorganized and rehabilitated.

THE Berlin Iron Bridge Company, of East Berlin, Conn., has secured a contract for a steel rolling mill building, to be erected at the instance of the Pennsylvania Bolt and Nut Company, of Lebanon, Pa. The building, which is to be 103 feet in width and 112 feet in length, is to have a steel frame. The roof and sides are to be of corrugated iron.

LAST week we said that the Salem (Mass.) Company had established a uniform rate to all its consumers, irrespective of the quantity used per month; but this statement is not in accord with the facts. Under the schedule in vogue prompt payment entitles the ordinary user to a rebate of 20 per cent., while those who use 20,000 cubic feet or over per month are granted a rebate of 25 per cent.

MR. JOSEPH A. HARRIS, formerly connected with the gas meter manufacturing firm known as Harris Bros. & Co., informs us that he has made a business engagement with Messrs. John J. Griffin & Co., of Philadelphia, New York and Chicago. It is hardly necessary to add that "Joe" knows all there is to know about gas meters.

THE amalgamation of the interests of the City Gas Light Company, of Norfolk, Va., and those of the Norfolk Gas and Electric Company, has been satisfactorily completed. The title of the succeeding Company is the City Gas Company, of Norfolk, and the officers of the Company are: Directors, A. W. Stark, W. H. White, J. G. Womble, Merritt T. Cooke and H. Hodges, of Norfolk; A. C. Humphreys, R. W. Stevenson, Frederick Edey, Fernando Yznaga and R. M. Hurd, of New York; and John D. McIlhenny, of Phila.; President and Treasurer, A. W. Stark; Vice-President and General Solicitor, W. H. White; Secretary, Wm. N. Grubb; Executive Committee, A. C. Humphreys (Chairman), J. D. McIlhenny and A. W. Stark.

THE Philadelphia *Record* is responsible for the following: "Our new cook has gone already." "What was the matter?" "When she found we had a gas stove she left; she had burned a ton of coal a week in each of her former places, and she said she had to be where she could live up to her record."

MR. GARRET A. HOBART, the candidate on the regular Republican ticket for the Vice-Presidency of the United States, is President of the Peoples Gas Light Company, of Paterson, N. J.

AT a meeting of the Lighting Committee of the Camden (N. J.) City Council the contract for the public lighting of that place was awarded to the Camden Gas Light Company. The prices agreed upon are as follows: Ordinary burners, $20 per year per lamp; single Welsbach burners, $24 per lamp; double Welsbach burners, $28 per lamp.

THE City Council, of Springfield, Ills., seems disinclined to grant an extension of time to the promoters of the Provident Gas Company under which the latter may construct their proposed opposition works. When the franchise was granted the instrument contained a provision declaring that, unless construction work was commenced within a certain time, the grant would lapse. The time limit expired before work was begun, but just prior to the lapsing the promoters asked for an extension. The Council referred the petition to a special committee, which committee finally returned the prayer to the Council without any recommendation, and the Board ordered that the same be laid on the table. This, according to our understanding, virtually kills the Provident Company's aspirations to supply gas in Springfield.

LAST year the Baltimore (Md.) Fire Department was called out 75 times to extinguish fires caused by the explosion of gasoline.

THE Boston (Mass.) *Transcript*, of the 19th inst., said: "A peculiar state of things was discovered to-day in the unoccupied house at 48 Beacon street, it being nothing less than that every gas jet in the house, from top to bottom, 24 in all, was going at full blast. The house was recently purchased by Mrs. J. B. French, and yesterday afternoon she called at the City Hall, and, leaving the keys at the Buildings Department, asked that one of the stairways be inspected, as she thought it was in an unsafe condition. Two inspectors were sent to the house this morning, and as soon as they got inside of the door they noticed the smell of gas. On the first floor three burners were found open, and investigation showed that the others were also going on all the floors, a total of 24 being full open. No one can imagine any reason for leaving the burners in this state."

SUPERINTENDENT W. A. BIXBY, of the Champaign and Urbana (Ills.) Gas Light and Coke Company, is very well satisfied these days, for the extensive scheme of betterments planned for the points named is nearing successful completion.

ON the 22d inst the Massachusetts Board of Gas and Electric Light Commissioners held a final session in the continued hearing on the various complaints of the town of Hudson and many residents thereof, all tending to prove that the Hudson Electric Light Company was charging exorbitant rates, and that the Company frequently refused to extend its wires to districts the residents in which desired to light their houses by means of electricity. From the testimony given the Company would seem to have the better of the argument. The Commissioners will hand down their decision in a few days.

WE understand that the works of the South Amboy (N. J.) Gas Company have gone into new hands.

ARTICLES incorporating the Los Angeles (Cal.) Gas Governor Company have been filed. The Company proposes to do business in Los Angeles, and it is capitalized in $25,000, of which amount $5,000 has been actually subscribed. The Directors for the first year are: William H. Bonsall, Lionel A. Sheldon, J. F. Conroy, Samuel J. Keese and G. Major Taber.

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MONDAY, JUNE 29, 1896.

Figures Worth Studying.

Mr. Frederick Egner, of Norfolk, Va., abstracting from an article in a recent issue of the *Journal für Gasbeleuchtung*, writes that the following interesting statements, concerning the use of gas for purposes other than lighting, comes from Winterthur, Germany. The population numbered 20,000, and the housekeepers, numbered by separate kitchens, were 4,300. For heating and motor purposes the 1,150 meters set, at the end of the year 1895, showed a total consumption of 29,271,536 cubic feet of gas—it is to be borne in mind that none of this quantity was used for lighting. Sixty meters supplying gas motors, having a total of 180-horse power, showed a use of 6,972,855 cubic feet of gas for the year. Other industries maintained 13 meters and consumed 3,496,262 cubic feet in the twelvemonth. Housekeepers, boarding houses, restaurants, etc., used a total of 18,902,419 cubic feet. The average consumption per annum and per family was as follows:

	Cu. Ft.	Per Person.
With two persons	13,550	6.775
" four "	21,364	5,341
" six "	29,740	4,937
" eight "	37,982	4,747
" ten "	46,189	4,619

In boarding houses, with from 11 to 25 persons, the proportion of gas used per head ranged as low as 2,542 cubic feet per annum. The proportion of gas used for purely domestic purposes (excluding illumination) was 25 per cent. of the total output. In Winterthur the services are put in free of charge, and the kitchen installations are put up at cost.

Fire Resisting Qualities of Wire Glass.

At a recent meeting of the Franklin Institute Mr. Charles A. Hexamer gave a brief description of tests lately made under his direction to determine the fire resisting qualities of wire glass. The results were to the effect that glass of this description might advantageously be employed for its fire resisting qualities, being quite equal in all respects to sheet iron for fire shutters. In these tests small furnaces made of firebrick, with wire glass bottoms, which were filled with oil saturated wood and allowed to burn for periods of half an hour or longer; streams of water were then thrown on the red-hot glass, which, while cracking into myriads of pieces, still retained its shape without warping or parting. Mr. William N. Jennings exhibited a set of photographs of the results of the recent cyclone at St. Louis, and stated that in the storm-swept portions of the city the buildings occupying four corners of intersecting streets were invariably completely destroyed; while perhaps the rest of the block would be uninjured. Some of the effects appeared to be due to some kind of an explosion. Buildings, for instance, would have their fronts entirely destroyed, and the debris would often fall outward, leaving the rest of the house intact. In some cases tall chimneys of flimsy construction were left standing, while all around it massive buildings were leveled, just as if the chimney had been the calm center of a whirling motion. Trees were invariably twisted off, and never appeared to be broken off.

The Market for Gas Securities.

There was really no market for city gas shares last week, although the prices quoted today (Friday) show no reflection of the dullness that ruled during the week. Consolidated is quoted at 158 to 160, and Mutual, Equitable and Standards are virtually the same as at time of last writing.

Brooklyn Union is some weaker, the ruling quotation being 93 to 93¼. Chicago gas is weak and sloppy, which condition is largely traceable to the half-defined belief that no dividend will be declared until late in the fall. Our idea, though, is that the disbursement is liable to be declared at any time; for it is always the unexpected that happens in respect of these shares. Bay State is returned at 22¾ to 23¼, and Baltimore Consolidated is in good request at 63 bid. The United Gas Improvement Company has declared a quarterly dividend of 2 per cent, payable July 15th.

Gas Stocks.

Quotations by Cochran & Close, Brokers and Dealers in Gas Stocks.

35 WALL ST., NEW YORK CITY.

JUNE 29.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,430,000	100	158	159½
Central	500,000	50	150	..
" Scrip	230,000	..	100	.
Equitable	4,000,000	100	203	208
Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bank	658,000	..	108	112
Mutual	3,500,000	100	225	235
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	.
Northern	150,000	50	79	80½
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	37	38½
Preferred	2,000,000	100	70	75
Bonds 1st 5's	3,500,000	1,000	102½	103½
" 1st Con. 5's	1,500,000	..	92	93½
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	78½	80½
Preferred	5,000,000	100	107½	109
Bonds, 1st Mortgage, 5's	1,500,000	1,000	110	112
Yonkers	299,650	50	180	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	93	93¼
" " Bonds (5's)	15,000,000	1,000	106½	107
Bay State	5,000,000	50	22¾	23¼
" Income Bonds	2,000,000	1,000	..	42
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	84	85
2d " " "	3,000,000	1,000	66	70
Buffalo Mutual	750,000	100	125	..
" Bonds	200,000	1,000	95	100
Central, San Francisco	2,000,000	..	95	..
Chicago Gas Co	25,000,000	100	66¾	67
Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds	7,550,000	1,000	94	94¼
Columbus	1,000,000	..	..	65
1st Mortgage	1,085,000	..	..	96
Consumers, Jersey City	2,000,000	100	..	80
" Bonds	600,000	1,000	99	101
Cincinnati G. & C. Co	7,000,000	100	198½	200
Consumers, Toronto	1,600,000	50	184½	187
Capital, Sacramento	500,000	50	..	41
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	1,000,000	100	63	63½
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,400,000	..	..	..
Detroit	4,000,000	..	32	33
" Con. Bonds	4,312,000	..	..	82
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	87	90
" Bonds	2,000,000	..	92	95
Hartford	750,000	25	.	145
Indianapolis	2,000,000	..	132	136
" Bonds, 6's	2,650,000	..	104	105½
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind	1,000,000	100	95	96
Bonds	1,000,000	1,000	98	98
Louisville	2,570,000	50	.	130
Laclede, St. Louis	7,500,000	100	21¼	22½
Preferred	2,500,000	100	80	83
Bonds	9,084,400	1,000	93½	93
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	.
Newark, N. J., Gas Co	1,000,000	..	98	98
Bonds, 6's	4,000,000	..	123	..
New Haven	1,000,000	25	225	..
Oakland, Cal.	2,000,000	..	52	53¼
" Bonds	750,000	..	..	..
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	2,100,000	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Paterson, N. J.	.....	25	90	102
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	88	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	94¼	95
St. Paul Gas Light Co	1,500,000	100	67½	70
1st Mortgage, 6's	650,000	..	84	87
Extension, 6's	600,000	..	..	..
General Mortgage, 5's	2,400,000	.	88	90
Syracuse, N. Y.	500,000	25	..	..
Washington, D. C.	2,000,000	20	250	..
Western, Milwaukee	4,000,000	100	63	66
Bonds, 5's	3,556,000	.	87½	90
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DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO., DREXEL BUILDING, PHILA., June 25, 1896.

The Directors have declared a quarterly dividend of 2 per cent. ($1 per share), payable on July 15, 1896, to stockholders of record at the close of business July 1st. Checks will be mailed.

1099-3 EDWARD C. LEE, Treas.

OFFICE OF THE LIGHTHOUSE BOARD, WASHINGTON, D. C., June 22, 1896. Proposals will be received at this office until 12 o'clock M., on Monday, the 13th day of July, 1896, for furnishing gas lighting apparatus for the ship channel lights, Mobile, Ala., regulators, piping, burners, gas compressor, boiler, etc., and for performing all labor necessary to completely erect these materials, partly on the Beacons of the Mobile Ship Channel and partly on a barge in Mobile Harbor, Alabama. The right is reserved to reject any or all bids, and to waive any defects. Forms of proposal, plans, specifications, and other information may be obtained on application to this office.

1099-2 THE LIGHTHOUSE BOARD, Washington, D. C

OFFICE OF THE LIGHTHOUSE BOARD, WASHINGTON, D. C., June 15, 1896. Proposals will be received at this office until 12 o'clock, M., of Tuesday, the 7th day of July, 1896, for furnishing and delivering illuminating gas for the Mobile Ship Channel Lights. The right is reserved to reject any or all bids, and to waive any defects. Specifications, forms of proposals, and other information may be obtained on application to this office.

THE LIGHTHOUSE BOARD, Washington, D. C.

Position Desired

By a man 24 years of age, who thoroughly understands his business (coal or water gas), also office work in all its details. Is at present in charge of a works, but for good reasons wishes to make a change. Has had 10 years' experience, and is not afraid of work. A position preferred where good service would be appreciated; salary is a secondary consideration. Best of references. Address

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A Small Gas and Electric Light Plant,

in a Southern city of 3,800 inhabitants.

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One 8-ft. Station Meter, with 12-in. connections. In good order. Can be delivered Aug. 1.

One No. 4 Wilbraham Blower.

Wrought Iron Hydraulic Main for six benches of 6's. Size of Main, 24 in. by 30 in; 8 feet casings. Arranged for 7-inch dip-pipes.

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BEAR CREEK CANNEL COAL

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Utilize Your Gas Liquor.

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Ammonia Concentrator.

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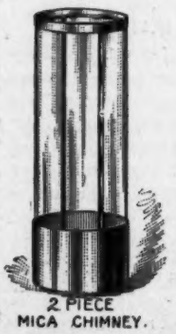

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Has been made by
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They control the pressure at the burner, and deliver the quantity for which they are set regardless of high or low pressure in the supply.
WELSBACH LIGHTS are fully controlled, and the governors soon pay for themselves by preventing the breaking of mantles and chimneys. Thousands are already in use. Orders may be given to the Welsbach Co., or sent to ourselves.
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ALL SIZES AND SHAPES.
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PURIFICATION
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COKE CARS for Gas Works,
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Will cut from 2 in. to 24 in.
Pipe Cutting Tool
For Cutting Cast, Wrought Iron, Gas & Water Pipes.
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THE HAZELTON OR PORCUPINE BOILER.
After Sixteen Years of Active Service in all the Principal Industries, this Boiler has Proven Itself Superior to all Others in Economy of Fuel, Durability, Safety and General Efficiency.
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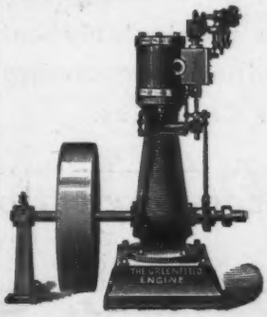
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Especially the Installation or Extension of Plants for the Manufacture of Gas from Caking Coal.

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No. 34 Light, with No. 10 and No. 43 Opal Shade.

CAUTION!

BEWARE of counterfeit lights which are being offered in genuine Welsbach boxes. See that each box bears our trade mark, "WELSBACH," and that the seals are unbroken before you accept it.

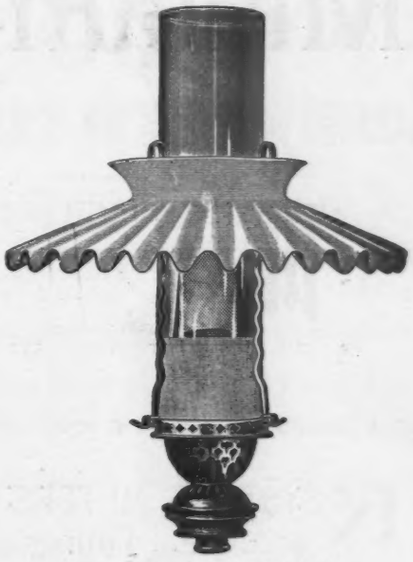
CAUTION!!

Persons dealing in counterfeit lights are liable to criminal prosecution, and a large number of indictments have already been found against such dealers.

All infringements of this Company's patents will be promptly and vigorously prosecuted, dealers and users being equally liable. This Company will prosecute all parties in whose possession infringing lights are found.

This notice is given in view of an effort now being made to introduce into this country infringing lights made in Germany, the sale of which, there, has been prohibited by the recent decision of the German Patent Office sustaining the validity of the Welsbach patents.

For your own protection, see that you get the genuine Welsbach light, as both the counterfeit and the infringing lights are greatly inferior.



No. 34 Light, with No. 74 Opal Shade.

Welsbach Commercial Co.,

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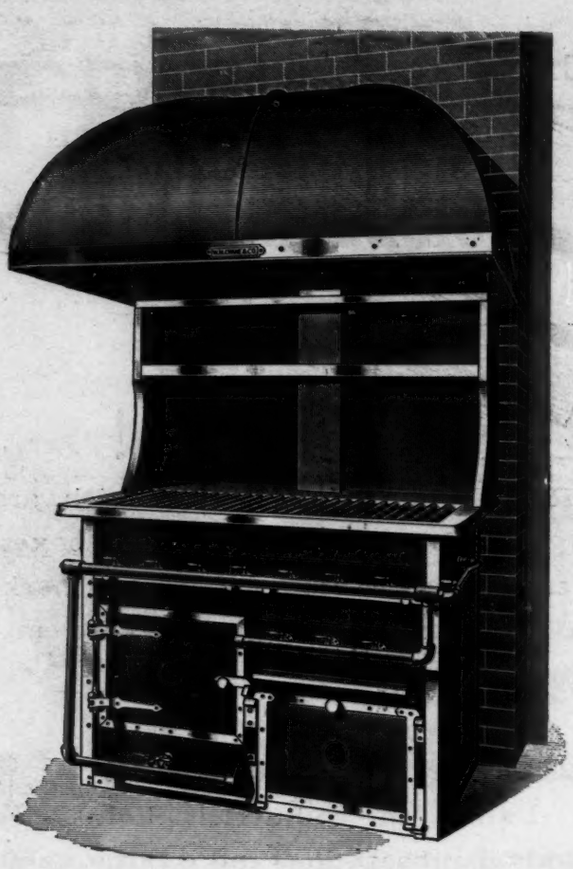

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WIESTER & CO.,
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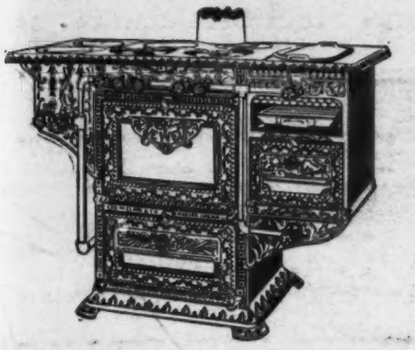
JEWEL GAS STOVES



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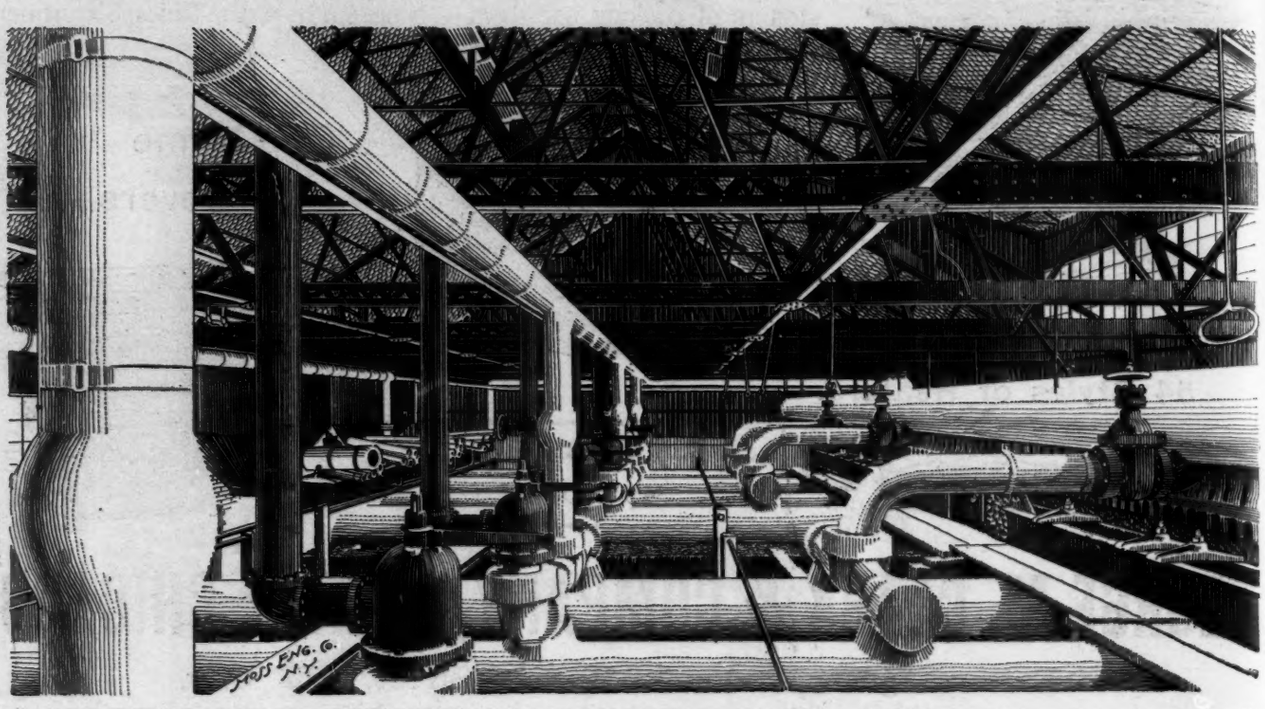
Engineers, Architects, and Builders of Iron and Steel Structures.



The above illustration is taken direct from a photograph, and shows the construction of a Boiler House designed and built by us for the well known Silk Manufacturing Company, Cheney Brothers, at South Manchester, Conn. The building is 48 ft. in width and 74 ft. in length, with brick walls to the height of the top of the boilers; above that the construction is entirely of iron, the Roof being covered with our Patent Anti-Condensation Corrugated Iron Covering, which we guarantee not to drip in the coldest weather. The construction is absolutely fireproof.

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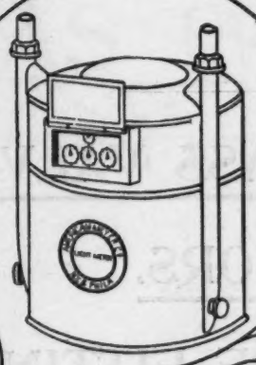

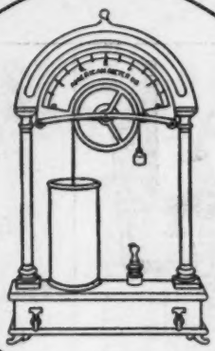

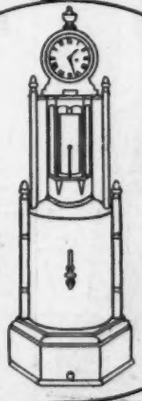

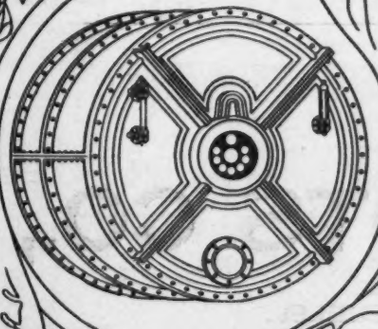

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NEW YORK AND PHILADELPHIA,

CHICAGO, ST. LOUIS,

SAN FRANCISCO.

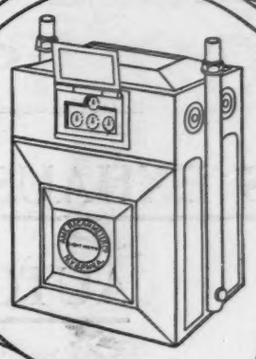
PUBLIC LIGHTING TABLE.

JULY, 1896.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Wed.	1	8.00 PM	12.00 AM	7.30	3.15
Thu.	2	8.00 LQ	12.30	7.30	3.15
Fri.	3	8 00	12.50	7.30	3.15
Sat.	4	8.00	1.10	7.30	3.15
Sun.	5	8.00	1.40	7.30	3.15
Mon.	6	8.00	2 20	7.30	3.15
Tue.	7	8.00	3.40	7.30	3.15
Wed.	8	8.00	3.40	7.30	3.15
Thu.	9	8.00	3.40	7.30	3.15
Fri.	10	8.00 NM	3.40	7.30	3.15
Sat.	11	8.00	3.40	7.30	3.15
Sun.	12	8.00	3.40	7.30	3.15
Mon.	13	8.00	3.40	7.20	3.15
Tue.	14	8.00	3.40	7.30	3.15
Wed.	15	9.10	3.40	7.30	3.15
Thu.	16	9.40	3.40	7.20	3.15
Fri.	17	10.10 FQ	3.40	7.20	3.15
Sat.	18	10.40	3.40	7.20	3.15
Sun.	19	11.20	3.50	7.20	3.15
Mon.	20	12.10 AM	3.50	7.20	3.15
Tue.	21	1.10	3.50	7.20	3.15
Wed.	22	2.20	3.50	7.20	3.15
Thu.	23	No L.	No L.	7.20	3.15
Fri.	24	No L. FM	No L.	7.20	3.15
Sat.	25	No L.	No L.	7.20	3.15
Sun.	26	7.50 PM	9.30 PM	7.20	3.15
Mon.	27	7.50	9.50	7.20	3.15
Tue.	28	7.50	10.10	7.20	3.15
Wed.	29	7.50	10.30	7.20	3.15
Thu.	30	7.50	10.50	7.10	3.30
Fri.	31	7.50	11.10	7.10	3.30

TOTAL HOURS LIGHTING DURING 1896.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	220.40	January	423.20
February	207.00	February	367.40
March	193.00	March	355.35
April	174.10	April	298.50
May	164.00	May	264.50
June	142.10	June	234.25
July	142 10	July	243.45
August	150.50	August	280.25
September	163.00	September	321.15
October	193.10	October	374.30
November	207.00	November	401.40
December	237.30	December	433.45
Total, yr.	2194.40	Total, yr.	4000.00



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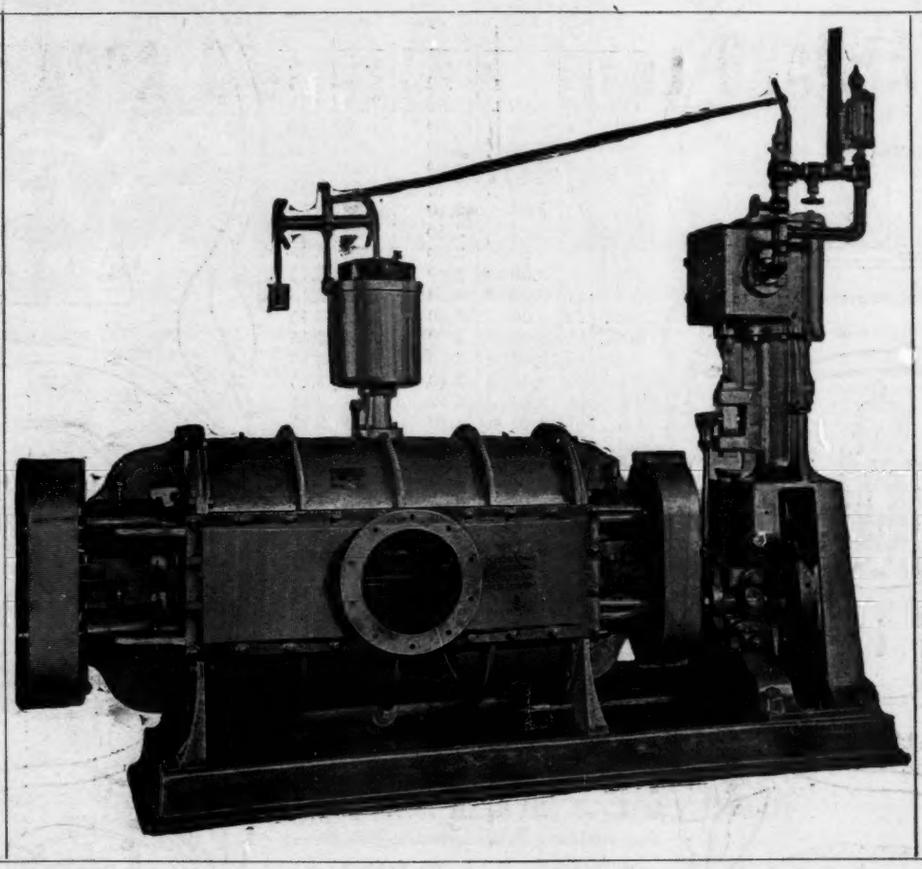

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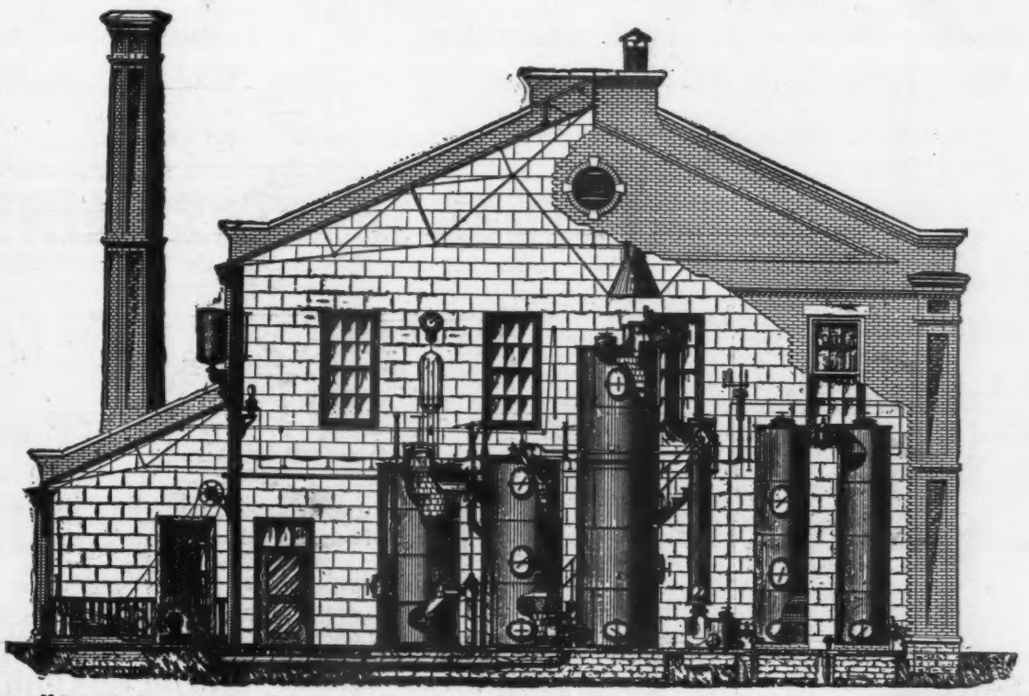

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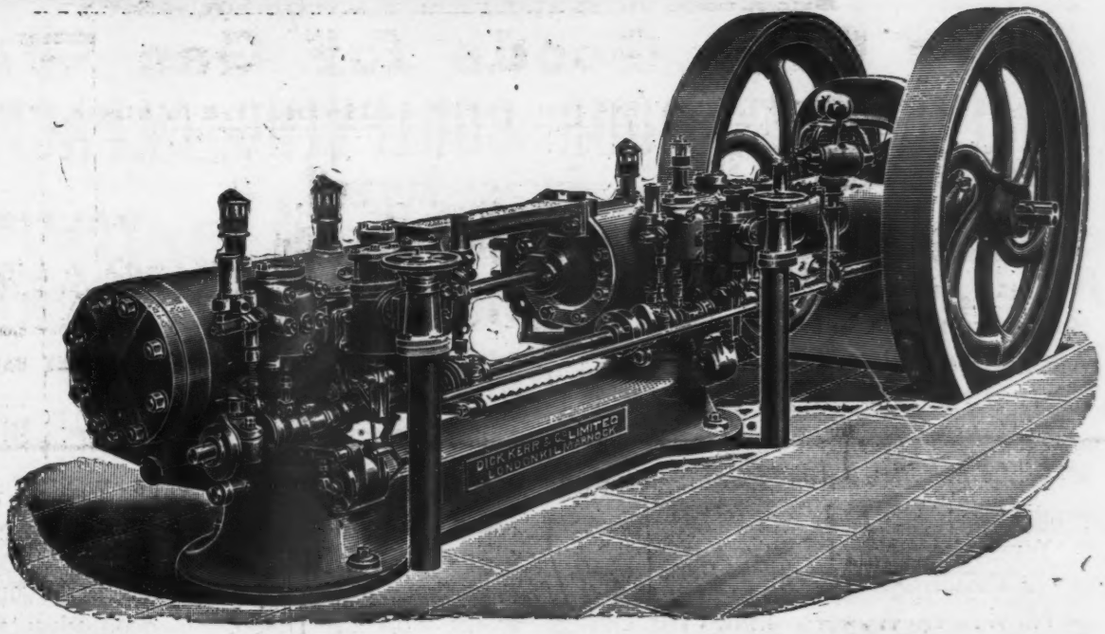

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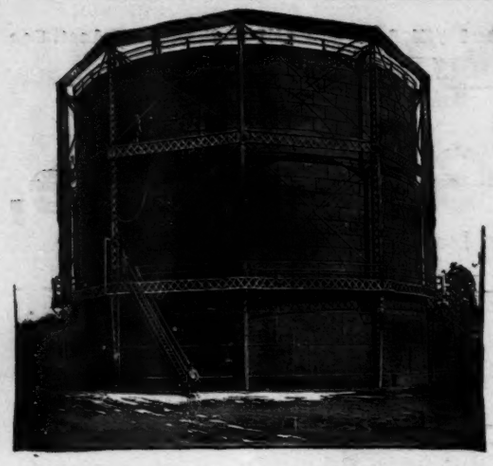

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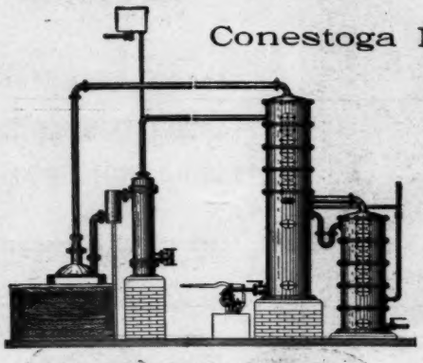

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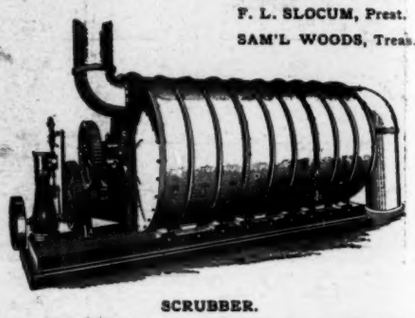

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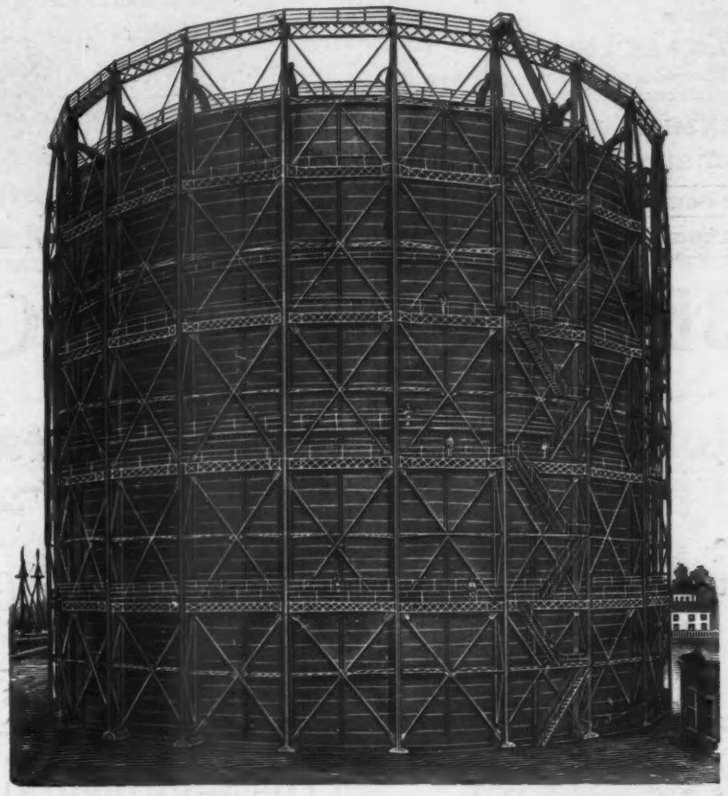

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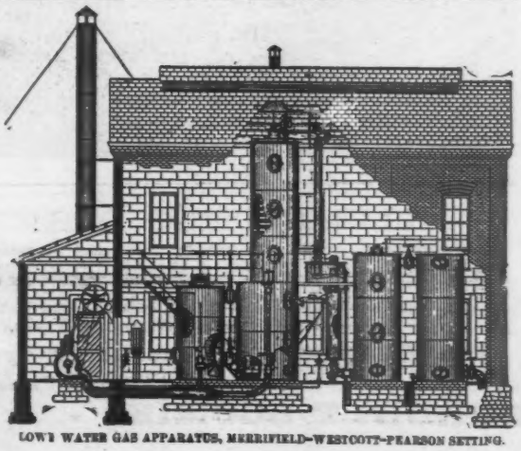

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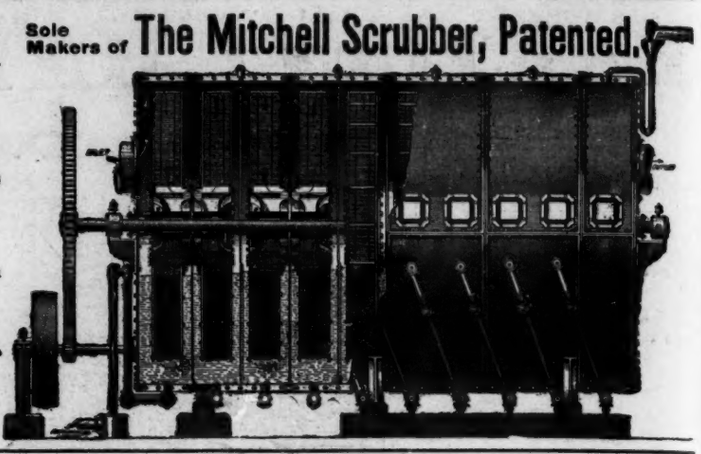

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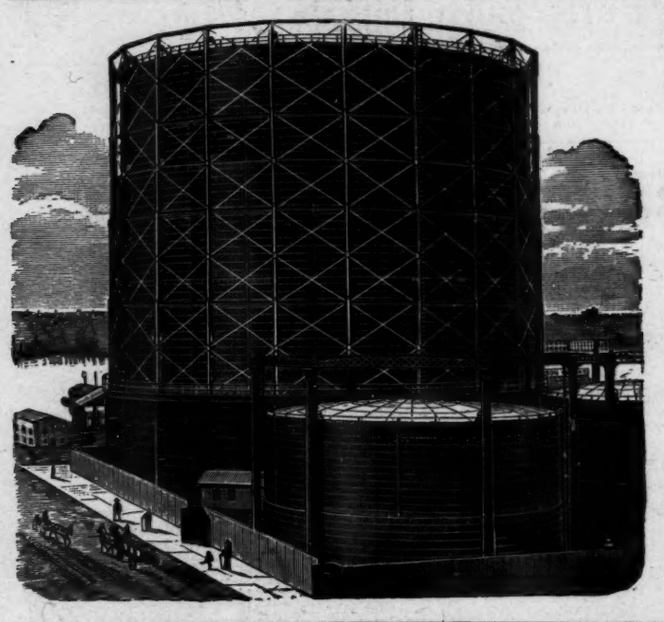

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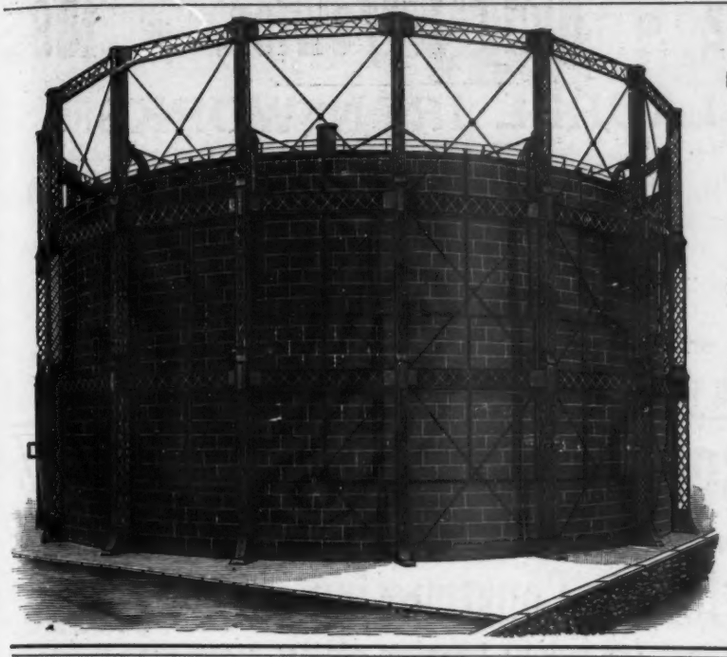

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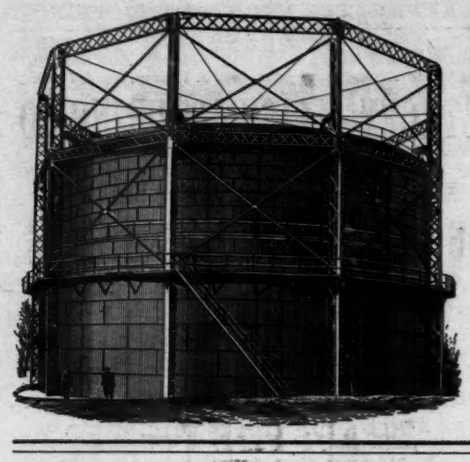

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